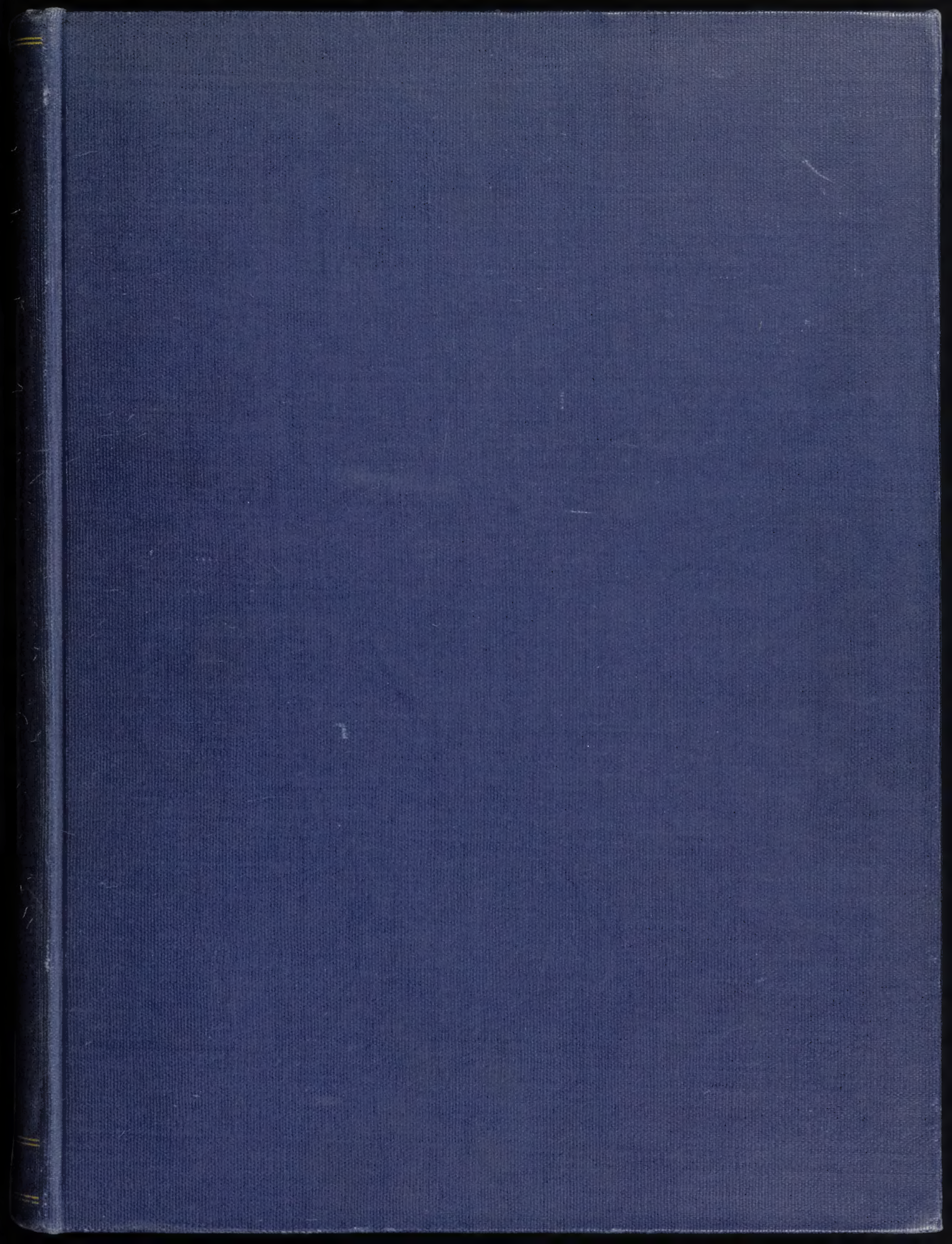
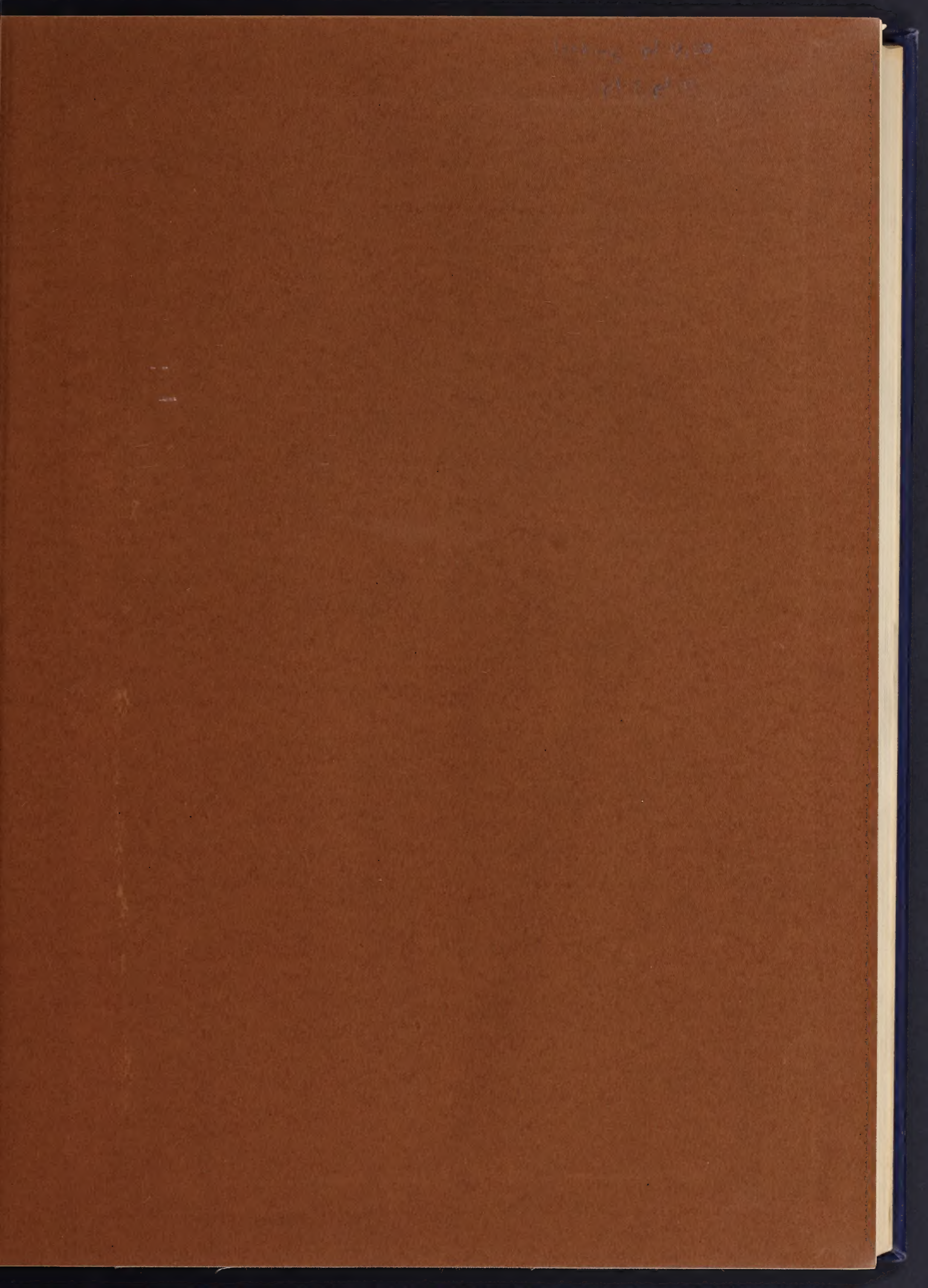






ART INDUSTRY

FURNITURE, HOUSE FITTINGS AND DECORATIONS

ILLUSTRATIVE OF

THE ARTS OF THE CARPENTER, JOINER, CABINET MAKER, PAINTER, DECORATOR, AND UPHOLSTERER

EDITED BY G. W. YAPP

ASSISTANT COMMISSIONER
AND COMPILER OF THE OFFICIAL CATALOGUES OF THE GREAT EXHIBITION OF 1851
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FURNITURE, UPHOLSTERY, AND HOUSE-DECORATION.



THE word "furniture" in French, *mobilier*, has a wide significance; it includes all objects, whether in metal, wood, marble, stone, or other material, not forming a part of the fabric itself, used in any place, public or private, civil or religious. Thus, under ecclesiastical furniture, we find the altar-plate, even the altar itself, the sacred vessels, rails, locks, and other iron-work. In our own language we have also remains of the same nomenclature in the expressions, "door furniture," "coffin furniture," "coach furniture," and other like expressions.

It is not in this broad sense that the word furniture is to be taken here; the first division of this work deals with Art-manufactures in iron, steel, brass, copper, gold, silver, and other metals, and the third division will comprise subjects belonging to the glass, china, and earthenware trades, carving, sculpture, &c. Furniture, then, is used here in the common acceptation of the term only, useful and ornamental objects made entirely, or principally, of wood; with this are associated upholstery, paper and other hangings, parquetry, carpets, floor-cloths, &c., and the decoration of walls and ceilings. The first subdivision will naturally be Working in Wood.

Nothing material can more strongly illustrate the habits and state of civilisation of a people, and of the condition of the Arts, useful and decorative, amongst them, than the furniture which they have in general use, making allowance always for difference of climate: the hammock is as indicative of the sunny south as the bed on the oven is of the icy zones. The destructibility of wood has naturally made very old furniture rare, but some highly interesting articles remain, and we have the forms of more in painting and sculpture, for the artist could no more represent home-life without furniture than man in society without clothing; again, when many articles of superior furniture were made of bronze or other metal, the forms were the same or nearly the same as those in wood, and thus represent them also. Amongst the most prolific storehouses of figures of furniture are the mural paintings of the Egyptians, the sculpture of all ancient nations, and the monuments of the Greeks and Romans. As we cannot all go to Egypt or Nineveh, it is fortunate that the domestic furniture and other articles used in ancient times have been carefully figured by Sir Gardner Wilkinson, Mr. Layard, and other travellers, and still more that in the British Museum there are many examples of antique furniture represented by the brush or the chisel, and some few actual examples of the articles themselves. Amongst the latter are several Egyptian chairs; one of ebony, turned and inlaid with ivory, and with a cane bottom, such as we see every day; there are also a table and some stools. The oldest representations of Greek furniture in the British Museum are in the Assyrian room, where there are several examples of seated figures; some of the chairs have straight backs, but one or two are of forms still not out of use; there are also X-shaped and other stools; in the same museum are also, in sculpture, a couch with turned legs and a tripod table with lion legs. Much interesting matter on this subject will be found in a shilling handbook on "Ancient and Modern Furniture and Woodwork," by Mr. Pollen, published by the Committee of Council on Education, and which contains many interesting illustrations.

Of Roman furniture we know much more than of older nations. The triumphal columns and arches—the Trajan Column, for instance, of which a fac-simile may now be studied in the architectural court of the South Kensington Museum—give some examples, and the discoveries at Pompeii and Herculaneum have enriched us not only with a solitary example or so of Roman furniture, but with rooms and shops entire, with much of their contents; most of the objects of any interest there discovered are now in the Museum at Naples. The British Museum, that of the Louvre, and many other national collections contain examples of Roman furniture. It may be interesting to state that the chair of St. Peter, at Rome, is supposed to be the oldest example of wooden furniture of Roman origin still in use; but it has been repaired and altered.

The ancients had tables, chairs, stools, couches, and bedsteads, but we have no traces of cabinets, sideboards, nor chests of drawers; shelves, brackets, and pedestals are supposed to have served the purposes of the first, and chests and boxes those of the last. The Romans, however, had rooms called *vestiaria*, in which they kept their clothes, but whether in presses or on pegs is not known. The chest of drawers is comparatively a modern piece of furniture, down to a recent period chests were the receptacles of all valuables, and much art was expended in their decoration. A "chest of drawers" may have originally meant chests which drew out, or drawer-chests; it is evidently a rather modern English word, having no connection with the name of the same article of furniture in France, *commode*. There is an old-fashioned piece of furniture, frequently found in country houses in France and in the *bric-à-brac* shops of Paris and other cities, called *bahut;* it is, in fact, a cabinet of the form of a chest, but set up on end, and with one or two shelves in it. These bahuts seem to furnish a kind of transition between the chest and the drawers. Sometimes two bahuts are placed near each other with a table between them; here we have at once a sideboard. Like the older chests, these bahuts are generally highly decorated with carving.

The characteristics of the furniture of the Middle Ages are well known to all the world; every cathedral and old church, almost every ancient castle and grand mansion presents examples, and the shops of the dealers in curiosities, *marchands de bric-à-brac*, as our neighbours call them, are full of them; though it is our duty to state that there is some old furniture which requires proof of its genuineness, just as there is much real old furniture without the slightest claim to beauty or any other good quality. The rage for Mediævalism, not the true admiration of Mediæval Art, has been of late years so violent that good taste is every day offended by the mixture of the ancient and the modern; in collections of objects of Art, incongruity is admissible—you visit them to see the special objects, you do not live there; but the admixture of Mediæval, and perhaps Chinese and Japanese furniture, with that of the present day in a modern drawing-room is barbarous, and to the artistic eye absolutely painful.

We have spoken of the wealth of our churches and old mansions in Mediæval furniture, for the stalls of cathedrals, as well as the panelled wood-work, the *boiseries* of the French, come strictly under the denomination; but the student in nearly any one of the great cities of Europe has still further opportunities for study. The finest and by far the most artistically kept Museum of Mediæval productions that we know of is that of the Hôtel Cluny, in Paris. Belgian museums also contain innumerable beautiful specimens. Lastly, the Museum of South Kensington, formed since 1851, contains already one of the finest collections in the world. For accounts of this, we must refer our readers to the catalogues of the museum and to the work already referred to, "Furniture," by Mr. Pollen.

We must not close these preliminary remarks without alluding to the results of the studies and efforts of our modern artists. Doubtless good taste has often been seriously offended by the reproduction of that which was utterly worthless, by the imitation of the ugly, simply because it was old, and by copies of vile paintings and sculpture; but so many English artists and Art-workmen have made their way into the arcana of Mediæval Art that they may almost be said to have resuscitated the school. In Germany and in France much has also been done in the same direction, and many of the very best results will be found represented in our pages. It is almost invidious to mention a few names out of the many which make up the roll of modern Mediæval artists and manufacturers, but we may mention those of Pugin, Hardman; Barnard, Bishop, and Barnards; Skidmore, Hart and Son, Wright and Mansfield, Cox and Son, Cookes, Tarver, Collinson and Loch, Talbert, Gillow, Crace, Fry, Holland and Son, Singer, Trollope and Son, Jackson and Graham, Myers, Walker, Morant, examples of whose productions, with those of other eminent artists, British and foreign, will be found amongst our illustrations.

It is highly satisfactory that contemporary with the revival of Mediæval styles there has been a similar one in the case of classic styles; and this, not in any one country, but in nearly all Europe. The beautiful forms of the Renaissance had passed through several phases and had at last degenerated to what is contemptuously called *rococo* in one country, while in another ornament had almost died out, and furniture had become massive and plain, sometimes grandly simple, at others simply ugly; at the present time it may be said that in almost all European countries not only Mediæval, but Renaissance and all the more modern styles, are produced in furniture with more knowledge, taste, and skill, than they had been for a long period.

For information respecting furniture in France, we cannot recommend the student in Art-Industry any better book of reference than "Les Arts au Moyen Age et à l'Epoque de la Renaissance," by Paul Lacroix, the learned antiquarian and author, better known as the "Bibliophile Jacob"—Jacob, the lover of books,—the sobriquet under which he used to write; this work is, moreover, one of the most brilliantly illustrated of its class that ever appeared in Paris. It was published by MM. Firmin-Didot, and has been translated and produced in London. It forms one large volume.

No. 1.—WOOD-WORKING.



UNLIKE many other trades, those of the workers in wood are known to all the world; to describe the common tools would be superfluous. We shall confine ourselves, therefore, to some remarks on timber and decorative woods and the old means of working them, and then speak of improved tools and of the machinery which of late years has, to a great extent, superseded hand labour in the production of articles of all kinds made of wood.

Little need be said about the timber woods properly so called, they do not belong precisely to our subject: they are oak, ash, beech, fir, pine, teak, chestnut, &c.* In joinery work cedar used to be much used, as it is very durable and does not require to be painted. Oak, we need scarcely say, was and is largely used in the same way for panelling, flooring, &c. On the Continent floors are generally laid with oak from one to two inches thick, which lasts as long as the house, and, if kept polished, looks well. In palaces in France, the Louvre, Versailles, and particularly Fontainebleau, the floors are laid with great care—some of the rooms at the last named and most interesting place are inlaid with charming designs. This kind of parquetry is of course expensive, but then it lasts as long as a hundred carpets of the best make, and is peculiarly agreeable and clean in summer.

Efforts are being made by several firms to introduce parquetry into general use in England, and now that the wood is cut out by machinery and thus the forms being all exact are not difficult to lay, it is probable that it may be largely adopted. A substitute for true parquetry is also produced, which consists of wood about the sixteenth of an inch thick glued in patterns on coarse canvas, so that it may be removed like carpets; nor must we omit to mention that many floors are now stained in imitation of oak and other wood, and if kept polished with beeswax, require no varnish and look extremely well. It may be added that the effect of large handsome rugs or squares of carpet in the centres of rooms, with the well-polished parquetry around, is extremely agreeable to the eye. This stained wood naturally calls to mind another innovation, namely, the use of pine wood for joinery purposes and in the manufacture of furniture without painting. Planks are selected which are clear of knots and show the best grain, and the work being well finished and finally varnished has a most pleasing effect, especially in the cases of Gothic, Tudor, or Elizabethan houses and furniture; but in any case such wood-work is preferable to broad painted surfaces or commonplace paper-hangings.

In old times our furniture was made principally of oak and walnut, and the curled grain of the pollards of these woods is very effective, but for a long period mahogany was used almost exclusively, and ebony, satin-wood, rosewood, &c., rarely. At the present time the list of ornamental woods in use for furniture is much extended, including bird's-eye and grey maple, Hungarian yew, olive, amboyna, &c.

The fine woods are now almost always used in the form of veneers, or very thin sheets cut from the most beautifully grained slabs that can be picked out, and by this means the wood can be arranged with infinitely better effect than when used solid—for instance, by using veneers from the same log and reversing them; this will be found well exemplified in a circular inlaid table, of olive wood, by Messrs. Jackson and Graham, which will be found amongst our examples of furniture.

The beautiful woods used for inlaying, but which are not obtained of sufficient size for yielding large veneers, are very numerous; the following are amongst the most remarkable: green ebony, sandal, citron, tulip (the *bois de rose* of the French, our rosewood being called *palissandre*), apple, cherry, plum, holly, beef-wood, king-wood, queen-wood, coromandel, locust tree, the so-called common acacia, zebra, yacca, snake, Palmira, purple-wood, and nutmeg-wood.

Nearly all woods are used for turning: alder, beech, birch, and willow for common ware; for Tunbridge ware, holly, horse-chestnut, sycamore, apple, pear, and plum; for skittle-balls, and other things in which toughness and weight are required, lignum vitæ, hornbeam, oak, elm, and beech; for ornamental work, ebony, box, cocoa or "cocus" wood, rose, and many others. Patterns for castings are made mostly of straight-grained deal, mahogany, or cedar, but sometimes of alder, lime, or pear-tree wood. In the case of pattern-making and cabinet work, it is peculiarly essential that the wood used should be thoroughly seasoned, that is to say, that sap should all be got rid of, or warping, splitting, and twisting may ruin the best work. This seasoning is a matter which requires considerable care and much time; some thin wood may be dried by exposure to the air for a year, but thick planks require three years. Wood may be seasoned by heat and other artificial means; but, as generally believed, not without injury to its power of endurance.

Wood-work is divided into three distinct trades, carpentry, joinery, and cabinet-making. The carpenter frames and puts together roofs, partitions, floors, and other essential parts of the building. The joiner only commences where the carpenter leaves off, by supplying and fitting stairs, cupboards, furniture, and other parts necessary to but not a part of the building.

We have little to do with the two former, but as the joining of parts is highly important, and as carpentry is the most scientific of all wood-work, we borrow from the "Cyclopædia of Useful Arts," edited by Professor Charles Tomlinson, the passages relating to the joints, for the benefit of those of our readers who do not possess that work.

Timbers may be connected lengthwise, where neatness is not an object, by simply bringing the two beams end to end, placing a short piece on each side, and bolting through these short pieces and the main beams. This form of joint is not neat, but it is simple, and if bolts and straps are well applied, it is as good to resist transverse as longitudinal strains. Ship-carpenters call it "fishing" a beam.

But where neatness is an object, beams are connected longitudinally by *scarfing*. In this case half of the substance of each beam is cut away for a certain length, and the cut portions being brought together, are fastened by screws, bolts, straps, or wedges. In designing the scarf, due regard must be had to the nature of the strain the piece is intended to resist, whether longitudinal, transverse, or both combined.

The common scarf joint, Fig. 1, is made by merely halving each piece

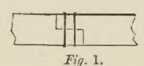


Fig. 1. *Fig.* 2.

of timber for a certain length, and then bolting or strapping the two pieces together. This has evidently no strength in resisting longitudinal strains, beyond that of the bolts and the adhesion or friction between the two timbers which they may cause. But more elaborate joints may be made (see Figs. 2 to 6), in which the resistance of the wood to splitting is brought in, either with or without bolts, to bear the strain. Figs. 4 and 6 are good examples of this kind of joint. These are to be drawn together when made by a key or by double wedges. Such a key is shown in the middle of the joint Fig. 6, and its place is indicated by dotted lines in Fig. 4. Such joints might be used without bolts or straps, but they are far safer with them.

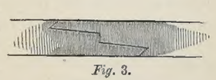


Fig. 3.

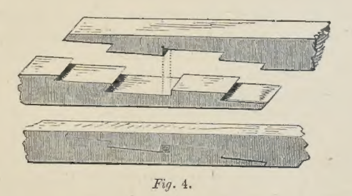


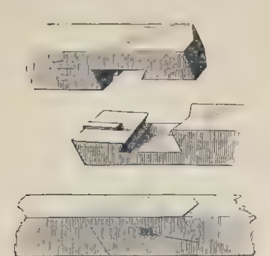
Fig. 4.

Fig. 7 shows the French scarf called *traits de Jupiter*, from its fancied resemblance to the form of a flash of lightning. This figure shows the mode of applying bolts and straps. If such a joint were made to resist a transverse and downward strain, it would be better to terminate the upper and right-hand end of the scarf by a plain butt end, of half the depth of the timber, to omit the indents on each side of the centre, and apply a key or folding wedges to the middle indent, making a half dovetail to the lower and left-hand end of the scarf. The reason of this change will be obvious, if we remember that with a transverse strain the upper surface is only compressed, and the lower surface only extended. The right-hand strap might

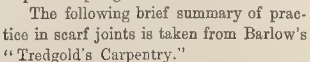
* The roof of Westminster Hall, one of the finest open timber roofs in the world, which was constructed in the reign of Richard II., and is still sound, is said to be of chestnut wood.

also in such case be advantageously removed to the place of the left-hand bolt.

Figs. 8, 9, show longitudinal joints which may be used where a vertical pressure only is to be borne. The joint is made very short, as the only object is to keep the two pieces in the same line. In Fig. 9, the end of each piece is divided into nine squares; five of these being cut away in one piece, and the four alternate squares in the other, the two ends fit into one another.


Fig. 5.

A common method of scarfing bond and wall plates is, to cut about three-fifths through each piece on the upper face of the one and the under face of the other, about six or eight inches from the end, transversely, forming what is called a *kerf;* and longitudinally from the end, from two-fifths down on the same side; so that the pieces lap together like a half dovetail.


Fig 6.

The following brief summary of practice in scarf joints is taken from Barlow's "Tredgold's Carpentry."

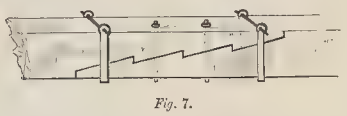
The length of the scarf should be, if bolts are not used—

In oak, ash, or elm, 6 times the depth of the beam.

In fir, 12 times the depth of the beam.

If bolts and indents are combined, the length of the scarf should be—

In oak, ash, or elm, twice the depth of the beam.


Fig. 7.

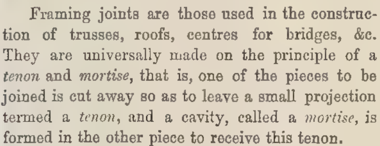
In fir, four times the depth.

In scarfing beams to resist transverse strains, straps driven on tight are better than bolts.

The sum of the areas of the bolts should not be less than one-fifth the area of the beam, when a longitudinal strain is to be borne.

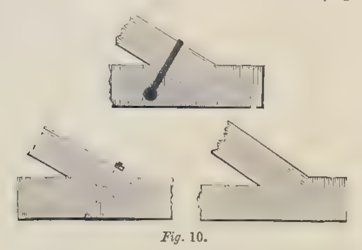
No joint should be used in which shrinkage or expansion can tend to tear the timbers.

No joint can be made so strong as the timber itself.


Fig. 8. *Fig. 9.*

Framing joints are those used in the construction of trusses, roofs, centres for bridges, &c. They are universally made on the principle of a *tenon* and *mortise*, that is, one of the pieces to be joined is cut away so as to leave a small projection termed a *tenon*, and a cavity, called a *mortise*, is formed in the other piece to receive this tenon.

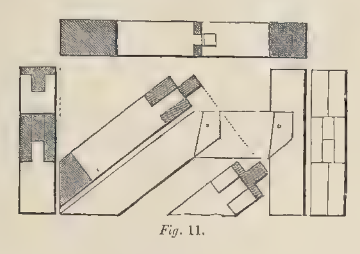
The tenon may be very short, so as not to pass through the other piece, as shown in Figs. 11 and 14. The use of such a tenon is only to prevent any lateral motion in the pieces joined together. Such a joint would be made at the connection of a king- or queen-post with the principal rafters (Figs. 12, 13, upper parts of the figures), or of the king- and queen-posts with the struts (see the lower parts of the same figures). The ends of king- and queen-posts are usually tenoned into the tie beams. With a similar view, to prevent lateral displacement, the feet of the principal rafters of a roof are tenoned into the tie-beam (Fig. 10). As the


Fig. 10.

pressure in this case is very oblique to the surface of the tie-beam, a bolt and nut, or, better still, a stirrup-iron or strap, is commonly used, as shown in the figure.

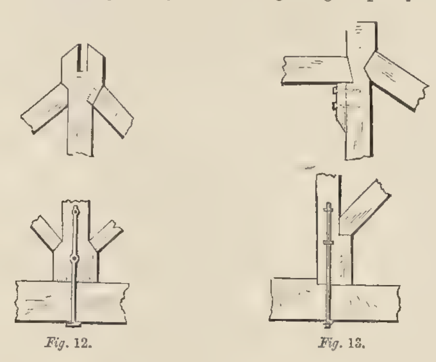
A very short tenon, called sometimes a *stub-tenon*, is used at the feet of uprights in partitions and bearers for floors (Fig. 16).

When tenons have not only to resist lateral displacement, but also a strain tending to draw them from their mortises, they must be *pinned* or

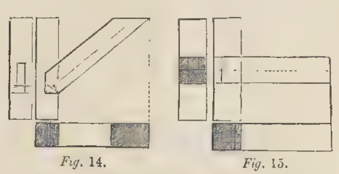

Fig. 11.

wedged. An oak pin or trenail, or an iron bolt, may be driven through both the tenon and the sides of the mortise, as in Figs. 11 and 14; or the tenon may be cut so long as to extend quite through the mortised piece, and have a cross pin passed through the projecting part. The last plan is commonly used in connecting *trimmers* or bridging-joists to the girders or main-joists in floorings.

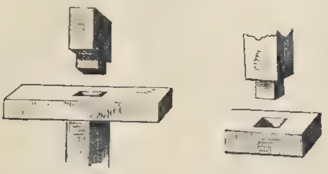
Wedging is done by making the tenon long enough to pass just through


Fig. 12. *Fig. 13.*

the mortised piece. A saw-cut is made in the projecting part, and a small wedge being driven in, the end of the tenon is expanded, and cannot be again withdraw from the mortise. If the piece cannot be mortised quite through, *fox-tail wedging* may be adopted. The tenon is made to fit the mortise exactly; two cross saw-cuts are made in its end, and small wedges are put loosely into these. When the tenon is driven down, the wedges meet the bottom of the mortise, are forced into the tenon, expanding its end, and the whole is fixed very firmly. The feet of king- and queen-posts (see lower part of Figs. 12, 13) are commonly tenoned into the tie-beam.


Fig. 14. *Fig. 15.*

Sometimes the tenon is cut to a half-dovetail form, and the mortise-hole made to correspond. A key or wedge driven between the straight side of the tenon and the straight side of the mortise forces the sloping parts together, and fixes the tenon in its place. A stirrup or strap, such as


Fig. 16.

shown in Figs. 12, 13, is far more trustworthy than such a joint, however well made at first.

Tenons are usually made one-third of the thickness of the timber they are cut from.

Framing and bearing joints should have their bearing surfaces as large

as possible, and cut, if possible, at right angles with the direction of the pressure, or (where one piece bears in the direction of its length upon another) in a circular arc, so as to distribute the pressure equally over the bearing surface.

The strength of a structure must never be made to depend on the stiffness of joints, but solely on the arrangement of its timbers. No joint can be made so good as by its own stiffness or resistance to motion to add anything to the strength of heavy framing.

Under the head of joints for ties and braces, we may include joints in wall-plates, purlines, &c. Wall-plates are very commonly joined by dovetailing, as shown in Fig. 17 (left-hand figure); but they are much better if

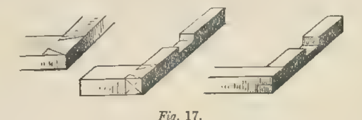


Fig. 17.

halved together, as in the right-hand figure, and pinned or bolted through. Dovetail joints should, in fact, never be depended upon in carpentry, where the grain of one piece of wood crosses that of the other. Timber shrinks far more across the grain than in the direction of its length, therefore dovetails, however well made at first, are liable through shrinkage to become loose, and thus throw all the strain on the pins or bolts, which were intended only to assist the joint. Dovetails can only be used with advantage when, as in joinery, and in the cases shown in Figs. 20 and 21 (left-hand figure), the grain of both pieces runs the same way. The

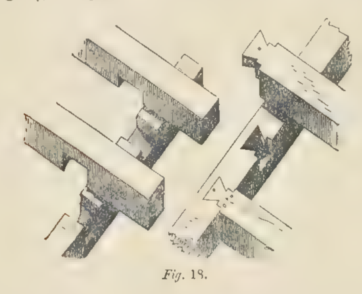


Fig. 18.

shrinkage of one then counterbalances the contraction of the other, and the joint remains firm. Such cases rarely occur in carpentry.

Tie-beams are connected to wall-plates by *cogging* or *cocking*. A shallow notch is cut out of the under surface of the beam, of the width of the wall-plate, and a similar notch cut in the wall-plate to receive the beam. The two notches fit together, and all motion, longitudinal or transverse, is prevented. Such a joint is shown in Fig. 18 (left-hand figure). The

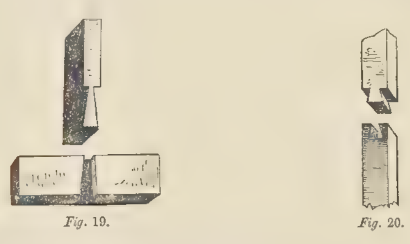


Fig. 19. *Fig.* 20.

right-hand figure shows a common way of connecting flooring-joists with trimmers or main joists. As there is seldom in such cases any great force tending to tear the joists from the trimmers, the dovetail form may suffice for all that is wanted. Such a joint would do for a brace between two

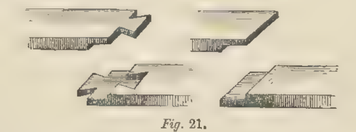


Fig. 21.

girders or main joists, where a thrust inwards was alone to be apprehended.

Fig. 22 shows a manner of fitting in a brace on each side of a beam. This joint is only adapted for pressure inward. If any force tending to separate the pieces be feared, the cogging shown in Fig. 23 may be used.

Purlines are *notched* down on the principal rafters, as shown in Fig. 18 (left-hand figure).

Fig. 19 shows another application of the dovetail joint, to which the remarks already made will also apply.

Two pieces are said to be *lapped* together, when a portion of each is cut away and the cut surfaces brought together, as in Fig. 21.

A careful study of the above will give a good idea of the mode of connecting pieces of wood together for all purposes. We need only add that

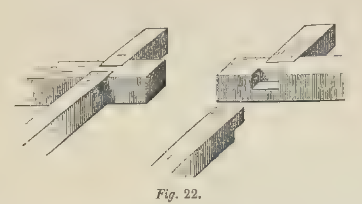


Fig. 22.

in small and unimportant matters great use is made of glue, and this, simple as it appears, cannot be used with success without attention to certain conditions. In the first place, the glue must be hot and liquid; in the second, the pieces to be joined must be made to fit closely, and have their surfaces perfectly clean; and, thirdly, the work must be allowed to cool under pressure so as to prevent the air entering and spoiling the joint. Cabinet makers manage this principally by means of wooden clamps, which hold the parts firmly together. Parts of furniture are often held together, or partly so, by means of pieces of deal glued in the minor angles; the examination of the ordinary furniture of any house will show how these are applied.

From the time of the invention of the lathe, which, we have already said, dates back to the epoch of the old Egyptians, we know of no improvement in the means of wood-working until very recent times, when water power was added to the saw, and produced the saw-mill, now driven by steam in every civilised town in the world. Of course saw-mills, gener-

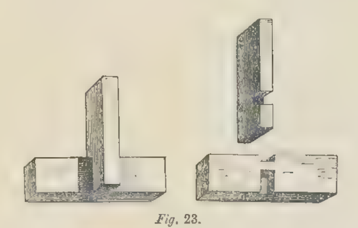


Fig. 23.

ally, have little to do with Art-manufactures, but the combination of a number of saws working together had an important effect on the production of veneers, a subject of great interest to the cabinet-maker.

The art of covering a cheap and inferior wood with a thin layer of wood of a more ornamental and costly character is not a modern invention. The elder Pliny refers to it as a recent invention in his time, suggested doubtless by the large sums which the luxurious Romans were accustomed to pay for solid tables of rare and costly woods; * he speaks of the ingenious art of converting the cheaper into the most valuable woods by plating them with the latter, so that by cutting a tree into thin slices it may thus be sold several times over.

In the cutting of veneers, it is of course desirable to economise the material as much as possible, and hence it is now usual to employ very accurate machinery for the purpose. They were formerly cut at the saw-pit, with very thin blades strained in the common pit-saw frame, or they were cut with the smaller frame-saw. Skilful pit-sawyers would cut 6 veneers out of every inch of wood, and cabinet-makers 7 or 8 from smaller pieces, but as the veneers increased in size the difficulties of cutting them accurately became great. Small veneers for the backs of brushes, &c., were split or planed from small pieces squared to the required sizes. The "scale-boards" for making hat and bonnet boxes are cut by a PLANING-MACHINE, as noticed under that head. The method of producing continuous shavings of this kind is important where the material is costly, for the ordinary veneer-saw

* The most costly wood in the time of Cicero was procured from a tree named *citrus*, a native of Mauritania, near Mount Atlas. In leaf, trunk, and odour it resembles the female wild cypress; the most valuable part is a tuber or warty excrescence, which when found on the root and underground is more esteemed than when growing on the branches. When cut and polished, it presents various figures, such as curling veins, or concentric eye-like spots; the former have procured for the wood the name of tiger-wood, the latter panther-wood. A table of this kind is said to have cost Cicero a million of sesterces, or £8,072 sterling. Even higher prices are quoted for the solid tables. See Mr. Aikin's paper on "Ornamental Wood," in the Transactions of the Society of Arts, vol. 1.

cuts on the average one-third of the material into sawdust. It is said to have originated in Russia, and by its means the veneers are cut spirally from a cylinder of wood with a knife of the same length as the cylinder. Ivory has been cut in this way into sheets of large dimensions. Pape, of Paris, some years ago veneered a pianoforte entirely with ivory, and advertised to supply sheets as large as 30 by 150 inches. In the United States Department of the Great Exhibition was an ivory veneer 12 inches wide and 40 feet long, cut out of a single tusk. In 1806, Mr. Brunel patented a method of splitting veneers of large size by means of a horizontal knife composed of several pieces of steel placed exactly in a line on their lower surface, but with their edges slightly rounded and very keen. A short reciprocating or sawing motion was imparted to this compound knife, and the block of wood to be cut up was carried slowly sideways beneath the knife by means of a screw-slide worked with a spoke-wheel. When one veneer had been cut off and the log restored to its first position, it was raised in exact parallelism by a system of two right-and-left-handed screws at the four angles of the frame, and which were all moved together by means of one winch-handle. This machine answered the purpose when veneers were to be cut from straight-grained and pliant woods, such as Honduras mahogany, but with woods of irregular and brittle grain, such as rosewood, the veneer curled up or split. The circular saw, although so wasteful of the material, is therefore commonly used for cutting veneers; and in order to give the saw sufficient strength, it is made thick towards the centre, and towards the edge it is thinned away almost to a feather edge. The solid block of wood or ivory is conducted along a parallel guide across the flat face of the saw, while the thin pliant veneer separates and forms an opening for the wedge-shaped edge of the blade, the veneer passing uninterruptedly along the conical back of the saw. For cutting large veneers, the saw is composed of a number of segments or plates of steel screwed to the edge of a metal disk, cast-iron wheel, or chuck, and is sometimes as much as 18 feet in diameter. In all veneer saws the edge must run very true, and the teeth must be sharp and very faintly set. If the segment veneer-saw exceeds about 4 feet in diameter, the horizontal platform or table is not used for guiding the wood, but a contrivance called the *drag*. In saw-mills where veneers are cut, the arrangement of the segment saw is called a *veneer-mill*. The axis of the saw runs in massive brasses, fixed on brick or stone piers; and if the saw be large, its edge is made to dip into a pit below the ground. The axis of the saw is connected or disconnected with the moving power by means of a fast-and-loose pulley. The log of wood is usually adzed over to remove sand and dirt, and is then partially levelled to adapt it to the vertical face of the drag. The log is held by iron fastenings or *dogs*, while its surface is levelled by the saw; it is then glued to a wooden frame containing transverse and oblique bars, which have also been levelled with the saw. By this arrangement the whole log can be cut into veneers without interruption from the joint. The timber is carried across the face of the saw by means of a rack and pinion acting on the drag, which is supported on a railway extending across the face of the saw. The axis of the pinion is furnished with a double train of toothed-wheels, and a clutch-box, the latter capable of being adjusted to 3 positions, by which the drag may be at rest or be carried slowly past the saw, or returned quickly back preparatory to another cut. The lever by which these motions are given is placed just behind the stool on which the workman is seated. Between every two veneers, the block requires to be advanced sideways through a small space equal to the thickness of the intended veneer. This is accomplished by means of adjusting screws, which act upon the standards which support the frame or wooden bars to which the wood is attached. The adjusting screws have worm-wheels at one end, and are simultaneously moved by a winch-handle, 50 or 60 turns of which are required to advance the log 1 inch, so that the veneers can by this adjustment be cut to any desired thickness. The thin veneer as it is cut is guided away from or in front of the saw by a feather-edged brass guide-plate, fixed almost in contact with the blade of the saw. As the veneer is being cut, the workman leads it on to the guide by means of a thin blunt chisel or *spud*; and it passes over the guide through a curved wooden trough, and when fully detached it is removed and placed in a heap of veneers already cut from the same log. The teeth of the saw are cleared of saw-dust by means of a *freeing-stick* applied beneath the timber during the action of the saw.

The number of veneers cut out of each solid inch of wood varies with the width of the veneers and the purpose to which they are to be applied. In general, when the width of the wood is 6, 12, 18, 24, 30, 36, 48, 60 inches, each inch of wood is cut into 15, 14, 13, 12, 11, 10, 9, 8 veneers.

As the veneers are cut they are rough on both sides, in which condition they are used by cabinet-makers for veneering articles of furniture. The operations of veneering consist in glueing the veneer to the prepared surface, and cleaning and polishing it when so fixed. Suppose the top of a table or of a sideboard is to be veneered. The workman first cuts out his veneer a little larger than the required size to allow for waste; he also cuts out a *caul* or board to prevent the clamp screws from leaving marks, and he next proceeds to scratch over the surface of the table or sideboard, and of the veneer, with an iron *toothing-plane*, which gives to the surfaces the required roughness, or *tooth*, or *key*, as it is called, for holding the glue. The clamps consist of strong wooden bars somewhat rounded on their inner edges, and connected by iron screw-bolts and nuts. The surface of the table being warmed, and the veneer and caul made hot, the table is brushed over with thin glue; the veneer is also glued and placed on the table: upon the veneer is put the heated caul, and the clamping bars are next quickly screwed down 3 or 4 inches apart. The heat of the caul retains the glue in a fluid state during the screwing down, which operation brings every part of the veneer into contact with the table, and forces out most of the glue. The table is generally left all night before the screws are removed. For curved work the cauls are also curved, and the clamp screws are numerous, in order to multiply the points of pressure.

Veneers are sometimes laid with a veneering hammer, which is a hammer with a very wide and thin face; or simply a piece of wood 3 or 4 inches square, with a round handle projecting from the centre: one edge of the head is sawn down for the reception of a piece of sheet-iron or steel, which is made to project ¼ inch, with a straight, smooth, round edge, and the opposite side of the square head is rounded to make it fit the hand better. The table and veneer are toothed, the surface of the table is warmed, and the outer face of the veneer and the surface of the table are wetted with thin glue or stiff size. The inner face of the veneer is next glued, and the veneer is held for a very short time before a blazing fire to make the glue very fluid; the veneer is then turned down upon the table and rubbed down by hand, several men being employed if the veneer be of large size. The greater part of the glue is then forced out with the edge of the veneering hammer, which is placed in the centre of the table, and gradually worked to the edge. A number of men are employed on this at once, and in order to keep the glue fluid, as also to relieve the friction of the hammers, hot size is occasionally applied to the surface of the veneer. When the work is judged to be complete, it is tapped all over with the back of the hammer; if the sound be anywhere hollow or *tacky*, the contact is imperfect and the hot size and the work of the hammer must be repeated; or if the glue be well set, the inner vessel of the glue-pot, or a hot iron, must be applied to the spot to melt it. Should the glue be in excess at one spot, the hot iron must be slowly moved towards the edge, so as to form a kind of channel along which the glue is pressed by the edge of the veneering hammer.

We may here just glance at the various kinds of saws most interesting to the wood-worker. In the first case we have the ordinary saws called hand and ripping saws, a tool, we believe, peculiar to our countrymen—at least, we have never found it on the Continent, where it is regarded as an expensive article, easily injured, and not very easy to use, in which view there is some truth. The common saw used in France, Germany, and most other countries, is a frame saw similar to that used by the woodcutter and represented in Fig. 24. The frame keeps the saw blade from buckling,

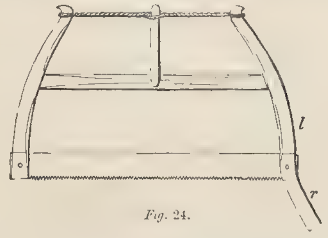


Fig. 24.

curving out of the straight line, and consequently very thin blades may be used, which is a great advantage in the case of expensive woods, as causing much less waste; moreover, they are much lighter than our ripping saws. The Continental frame saws are made upon the principle of the above, but with some modifications, and of various sizes; the frames are mostly square or have parallel sides, and the blades are set in sockets so that the frame may be turned at right angles to the plane of the saw, to allow of cutting down long planks, logs, &c.

In all these frame saws the side pieces are only connected with the central crosspiece of the frame by pins, so that when the twisted cord above is tightened or loosened the saw is acted upon in like manner; the lever is prevented from flying back by the central bar or stretcher already mentioned; when the saw is not in use the lever is reversed one turn, to relieve the tension, which is so great that one turn too much will sometimes break off the end of the saw or cause the frame to give way. The common woodman's saw represented above is grasped at *l* or *r*, but the Continental carpenters' and cabinet-makers' saws have no handle piece and are grasped at *l*. This reference to one kind of foreign saw as compared with that used for the same purpose in England reminds us of another which is mentioned

by the late Mr. Holtzapffel in his admirable work on "Mechanical Manipulation," and which well deserves to be repeated. Saws generally cut by being pushed from the workman, and if the blade be slight, as in the case of a key-hole saw, a very hard knot or any other obstruction will often cause the blade to snap in two: the Indian cuts the teeth of his saw in the opposite direction, so that they cut when he draws the tool towards him; the superiority of the Indian method is self-evident. It may further be mentioned that in certain saws—those used for cutting down trees and worked by two men, for instance—the teeth are V-shaped, sometimes with the point cut off horizontally, and cut in both directions.

The following are the principal forms of teeth in use. In general, the angles of the points of the teeth are more acute the softer the material to be sawn.

Fig. 25 *a* is a common form of tooth, called the *peg tooth*, or the

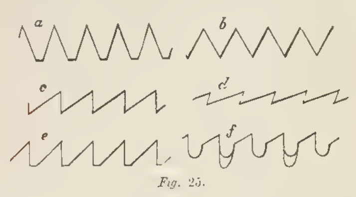


Fig. 25.

fleam tooth. This, as well as *b*, is used for *cross-cutting saws*, or those which cut across the fibre of the wood: the saw has a handle at each end, and is worked by two or more men, as in cutting down trees and dividing them when they have been felled. Similar saws are used for cutting the soft building stones when first got out of the quarry. The *gullet tooth*, *f*, is also used for cutting timber across; *c* is the tooth in most general use; it is known as the *ordinary-pitch* or *hand-saw tooth*, and is much used by cabinet-makers and joiners; also for circular saws for fine work, such as veneer saws, and for many cross-cutting circular saws, and for saws used for metal. In some cases the acute angular notch is not continued to an internal angle, as in *e*, a form adopted in some mill-saws, both of ordinary or perpendicular pitch, as well as for those of greater pitch. This kind of tooth being more acute than 60°, does not admit of being sharpened with the 3-square or equilateral file, but with a thin flat file, with square or round edges, called the *mill-saw file*. Angular mill-saw teeth are more readily sharpened than the *gullet teeth*, *f*, so named from the large hollow or gullet cut away in front of each tooth in continuation of the face: they are also called *briar teeth*. The gullet allows the tooth to be sharpened with a round or half-round file, by which the face of the tooth becomes concave when seen edgeways, and acquires a thin and nearly knife-like edge. The additional curvilinear space leaves more room for the sawdust, and is less disposed to choke than the angular notch. The gullet is sharpened with a round or half-round file. In some cases each alternate tooth is cut out, and the saw is then called *skip tooth*. In all cases the teeth have to be *set*, that is, they have to be inclined alternately right and left in order that they may make a cut rather wider than the body of the saw, or the friction would prevent the possibility of working at all. The manner in which the setting is effected will be readily understood from Fig. 26.

The ripping and half-ripping saws have large teeth, and are intended to cut quickly in the direction of the grain of the wood. Similar saws, called panel and fine panel saws, with finer teeth, are used for cutting mahogany and other woods with the grain; but the saws mostly used by the cabinet-maker have an iron or brass back and fine teeth; they are made of several sizes and are called *tenon* and *dovetail saws*, and cut with cleanness and accuracy, especially when the work can be laid in a wooden guide, when angles may be cut of any degree required, so that, in the phraseology of the workshop, the pieces thus cut shall *mitre* exactly.

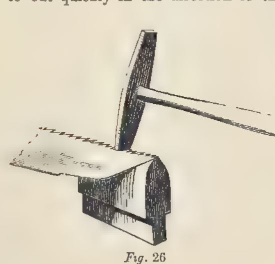


Fig. 26

The other kinds of saws in use are narrow taper saws for cutting round curves, key-holes, &c., and are known as *table* and *key-hole saws*; lastly, there is the fret saw for cutting inlays, which is a narrow saw fixed in a metal frame, on the same principle as the woodcutter's frame saw represented in Fig. 24.

The introduction of the circular saw about the end of last century, for the date is not certain, formed an epoch in wood-working. In saw mills time had been gained by setting half-a-dozen or more saws in vertical frames and working them together, thus saving much time, but the introduction of the circular saw left such arrangements far behind. The circular saw soon grew to its present enormous proportions; and one of these tools several feet in diameter with teeth 3 and 4 inches deep, flying round at great speed, is certainly a startling instrument to see in operation for the first time—with sharp-set teeth and great velocity it divides huge logs of timber and planks as if by magic. Of late, saws have been made with teeth separate from the body of the saw, exhibiting much ingenuity. In the shop the circular saw, either in a small frame of its own or on a lathe, is of immense value. A small table with a slit in it is fixed in such a manner that the saw comes up through the slit as far as possible, or the table may be set to limit the cutting power of the saw to a slight depth only; then, with the assistance of a metal guide, which can be set at any desired angle to the face of the saw, the material may be cut at any angle, and either entirely or partially through the wood. For hard wood, ivory, &c., the saw has comparatively small teeth, finely set, and is not run at great speed. Lastly, another saw of great utility, the *band* or *ribbon saw*, has since been introduced, and will be described farther on. The chisels, gouges, and other cutting tools, and the numerous small tools used by all workers in wood need not be mentioned, they are to be seen in every tool shop.

The case is not, however, the same with respect to planes—the principle, and even the parts, of which cannot be seen or understood at a glance; besides, cabinet-making depends upon the plane almost entirely for mouldings and beadings, which form so much of its ornamentation that a full description is called for.

The plane used in carpentry is a chisel set in a stock or guide for the purpose of regulating the depth to which it penetrates the wood, so as to enable it to cut instead of split the wood, and also for furnishing a well-defined guide to the path or direction of the cutting edge. The sole or stock of the plane is usually an accurate counterpart of the form which it is intended to produce, and as in the majority of instances this is flat or plane, the instrument derives its name from this form. The sections of planes may, however, be concave, convex, or mixed, as well as straight, whence arise those numerous varieties known as *grooving planes* and *moulding planes*. Planes used for flat surfaces are termed by the joiners *bench planes*, or *surfacing planes*. These are all similar as regards the arrangement of the chisel, or *iron* as it is termed, but the size may vary. In ordinary bench planes the width of the iron ranges from about 2 to $2\frac{1}{2}$ inches. The names and dimensions of surfacing planes are given in the following table:—

	Length in Inches.	Width in Inches.	Width of Irons.
Modelling planes, similar to smoothing planes	1 to 5	$\frac{1}{4}$ to 2	$\frac{7}{16}$ to $1\frac{1}{2}$
Ordinary smoothing planes	$6\frac{1}{2}$ to 8	$3\frac{1}{8}$ to $3\frac{3}{8}$	$1\frac{3}{4}$ to $2\frac{5}{8}$
Rabbet planes	$9\frac{1}{2}$	$\frac{3}{8}$ to 2	$\frac{3}{8}$ to 2
Jack planes	12 to 17	$2\frac{1}{2}$ to 3	2 to $2\frac{1}{4}$
Panel planes	$14\frac{1}{2}$	$3\frac{1}{2}$	$2\frac{1}{2}$
Trying planes	20 to 22	$3\frac{1}{4}$ to $3\frac{3}{8}$	$2\frac{1}{8}$ to $2\frac{1}{2}$
Long planes	24 to 26	$3\frac{5}{8}$	$2\frac{5}{8}$
Jointer planes	28 to 30	$3\frac{3}{4}$	$2\frac{3}{4}$
Cooper's jointer planes	60 to 72	5 to $5\frac{1}{4}$	$3\frac{1}{2}$ to $3\frac{3}{4}$

Of these planes, those most commonly used are the jack plane for the coarser work, the trying plane for giving the work a better figure, or trying its straightness and accuracy, and the smoothing plane for finishing the surface. When the wood is very rough and dirty, two jack planes may be used.

The different parts of the ordinary surfacing plane will be understood by referring to Fig. 27, in which the line *s s'* is the *sole*; *m b*, the line on

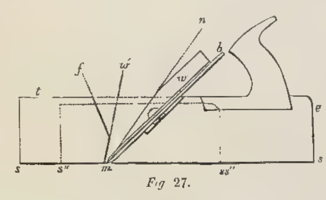


Fig 27.

which the plane iron is supported, the *bed*; and this in planes of common pitch is usually at an angle of 45° with the perpendicular. The narrow opening between the face of the iron and the line *m w'* is termed the *mouth* of the plane; the line *m w'* is called the *wear*; the angle between the mouth and the wear should be as small as possible, so that as the sole wears away or is corrected, the mouth may not be too much enlarged; this angle must, however, be large enough to allow the shavings to escape freely, otherwise the plane will *choke*. The line *f* is the *front*, and its angle is usually set out $\frac{1}{4}$ inch wider on the upper surface than the width of the iron. The iron is fixed in its place by a wedge *w*, by slightly driving it between the face of the iron and the shoulder *m n*. The wedge, shown separately in Fig. 28, is cut away at the central part to clear the screw which connects the two parts of the iron, and to allow space for the shavings to escape. The wedge is

Fig. 28.

loosened by tapping the end at *e*, or the top at *t*, or by tapping the side of the wedge itself; it may then be pulled out. A blow on the front of the plane at *f* sets the iron forward or deeper. The iron is somewhat narrower than the stock, and the mouth is a wedge-shaped cavity. When the stock terminates at the dotted line *s'' s''*, it represents the *smoothing plane;* when of the full length, with the handle or *toat*, it is the *jack plane* or *panel plane.* The sole of the plane rests upon the face of the work, and the cutter stands as much in advance of the sole as the thickness of the shaving, which is so bent as to allow it to creep through the mouth up the face of the incline iron. Considerable advantage is gained in having a double iron as in Fig. 29, the top iron not being intended to cut, but to present a more nearly

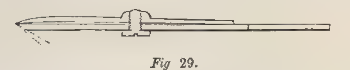


Fig 29.

perpendicular wall for the ascent of the shavings; and as this iron more effectually breaks the shavings it is termed the *break iron.* The lower piece is the one that cuts; the upper piece or top iron has a moderately sharp edge; it is placed from $\frac{1}{16}$th to $\frac{1}{30}$th of an inch from the edge of the cutter, and the two are held closely together by a screw passing through a long mortice in the cutter, and fitting into a tapped hole in the top iron. By the addition of the top iron the plane works more smoothly, but harder, and the more so the closer it is down, showing that its action is to break or bend the fibres: the shaving, being very thin, is constrained between the two approximate edges, and as it were bent out of the way to make room for the cutting edge, so that the shaving is removed by absolute cutting, not by being split or rent off.

The angle at which the plane iron is inserted in the stock depends upon the use to which it is applied. The spokeshave is the lowest of the series, its inclination being from 25° to 30°. In bench planes, for deal and similar soft woods, it is 45° from the horizontal line; that is called the *common pitch.* In bench planes for mahogany, wainscot, and hard or stringy woods, the *York pitch*, or 50°, is used. In moulding planes for deal and smoothing planes for mahogany and similar woods, the *middle pitch*, or 55°, is used. In moulding planes for mahogany and woods difficult to work (of which bird's-eye maple is said to be one of the worst), *half pitch*, or 60°, is adopted. Close hard woods, such as box, may be scraped smooth in any direction of the grain with a cutter placed perpendicular, or even inclined slightly forward. A tool with the cutter so arranged is called a *scraping plane*, and is used for scraping the ivory keys of pianofortes, and works inlaid with ivory, brass, and hard woods. In the process of veneering, use is made of a scraping plane, with a perpendicular iron grooved into a series of teeth instead of a continuous edge, for roughing or scratching veneers, and the surfaces to which they are attached by means of glue. In the smith's plane for brass, iron, and steel, the cutter is vertical.

Planes work smoothly with the grain of the wood, which must always be considered in the operation of planing. Some of the ornamental woods, however, owe their beauty to the extreme irregularity with which their fibres are arranged, and in certain directions the fibres are liable to be torn up by the plane. By applying the smoothing plane at various angles across the different parts of the surface, the desired effect may be attained; but with some curly, knotty, and crossed-grained woods the *steel scraper* must be used instead of the plane. The steel scraper (which had its origin in a piece of broken window-glass, still used by some of the gun-stock makers) is made of a thin piece of saw-plate; the edge is first sharpened at right angles upon the oil-stone, and is then burnished square or at a small angle, so as to throw up a trifling burr or wire edge. The scraper is held on the wood at about 60°.

Hard woods admit of being planed across the grain, both with flat and moulding planes. With deal and other soft woods, if a cutting edge be applied to the fibres parallel with themselves, or laterally, they are liable to be torn up and present a rough unfinished surface. A keen plane of low pitch is therefore used for such woods, and it is made to slide obliquely across the wood, so as to attack the fibres from the ends. Moulding planes do not admit of this application; mouldings in soft woods are planed lengthways of the grain, and added as separate pieces: but as rabbets and grooves

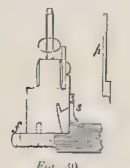


Fig 30.

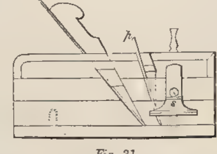
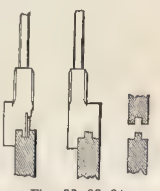


Fig. 31.

are frequently required to be made across the grain, the obliquity is then given to the iron, which is inserted at an angle, as in the *skewed-rabbet* and *fillister*, and the stock of the plane is arranged in various ways to guide the iron. Fig. 30 is the back view, and Fig. 31 the side of a side-fillister, for planing both with and across the grain; as in planing a rabbet round the margin of a panel. The loose slip or fence *f* is adjusted to expose so much of the oblique iron as the width of the rabbet; the screw-stop *s*, at the side, is raised above the sole of the plane to suit the depth of the rabbet, and the small tooth or scoring-point *p*, shown separately at Fig. 30, precedes the bevelled iron and divides the fibres so as to make the perpendicular edge true and square. The *plough* is also a grooving plane, in which the fence is secured to two transverse stems passing through mortices in the body of the plane, and fixed by wedges. *Slit deal planes* belong to this class, as in Figs. 32, 33, of which the one makes the groove, and the other the tongue, used for connecting boards for partitions, &c., with the *groove and tongue joint*, Fig. 34. There are many other forms of plane adapted to special uses, an account of which, including *moulding planes*, is given in the admirable chapters on "cutting tools, chisels, and planes," in the second volume of Holtzapffell's "Mechanical Manipulation," to which we are indebted for many of the details in this article. A remarkable form of plane was patented in 1844 by Messrs. Silcock and Lowe, of Birmingham, and has met with approval from practical men.



Figs. 32, 33, 34.

It is a *double fillister plane*, so constructed as to be capable of filleting boards of all sizes, from about $\frac{3}{8}$ths of an inch to about 3 inches, and may be adapted to the several purposes of a *filleting plane*, a *side fillister*, a *sash* or *back fillister*, and a *skewed-rabbet plane.* (*Fillister* from the Latin *filum*, a thread; and *rabbet* from the French *raboter*, to plane.)

Fig. 35 is a top view of the right-side plane of this double fillister, and

Fig. 35.

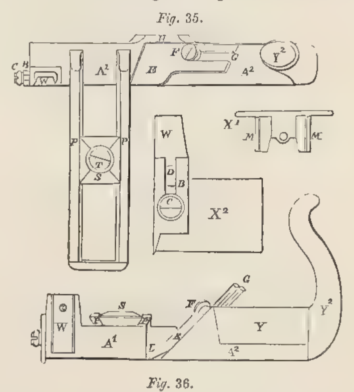


Fig. 36.

Fig. 37 a similar view of the left-side plane: Fig. 36 is a side elevation of Fig. 35, and Fig. 38 a side elevation of Fig. 37. These two planes when joined together by the chase or frame P form the complete tool. A¹ A¹ are the fore parts of the body of each plane, and A² A² the back parts; H H are the pieces which connect the front and back parts; Y¹ Y¹ are the stocks, and Y² Y² the handles. B B are the vertical cutters attached to the front ends of the planes. X² is a front view of one of these cutters; it is fixed in its place partly by a screw C passed through a cleft in the upper end of the cutter, into the fore end of the body of the plane, and partly by a pin D, which projects from the fore end and fits into the cleft,

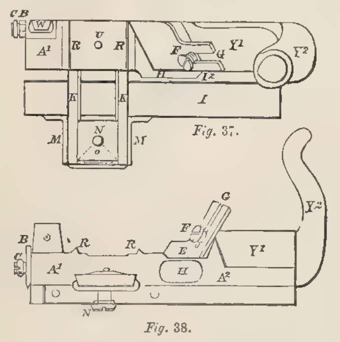


Fig. 37.

Fig. 38.

the object of the pin D being to keep the cutter perpendicular to the side of the plane, and to prevent its being driven aside when in use. E E are the horizontal cutters or *irons*, which are not secured to their beds by wedges, but by screws, F F, passed into the stock through clefts, G G, in the top ends of the irons. L is the mouth of the plane; P is a chase or frame projecting from, and attached at the inner end to the top of the fore

part A^1 of the body of, the right-hand plane, and slides into a recess, R R, on the top of the fore part A^1 of the body of the left-hand plane, the outer edges of the chase P being bevelled inwards, and the inner edges of the recess R bevelled outwards.

The length to which this chase P is slid into the recess R regulates the distance between the two planes, and this may be varied to suit boards of all sizes between the limits already mentioned. The planes are fixed at the required distances from each other by means of a traversing small screw T attached to the chase P, and in the recess R is a corresponding hollow screw U: the screw T has a sliding cushion S, by which it can be moved to and fro to any part of the frame P, and the sides of the cushions are bevelled to correspond with the bevelled inner edges of the chase P; I is a fence by which the distance between the check or fillet and the front of the deal is regulated. I^2 is the inner-edge plate of the fence. K is a chase or frame similar to P, and projects from, and is attached at the inner end to the bottom of the fore part of, the left-hand plane, and M (shown separately at X^1, Fig. 35) is a third chase, which projects from, and is attached to, the outer edge of the fence I. The chase M sliding within the chase K, and the two chases having for this purpose corresponding bevels at the parts where they come in contact, the lower chase M carries a fixed screw N, and the upper one a sliding nut O, similar to the sliding cushion S, so that when the fence has been adjusted to any required position, it is secured by bringing the nut O over the screw N and screwing up the one into the other. To regulate the height to be given to the fillet, a stop, shown in side and top views, Figs. 39 and 40, is used. The stem V of this stop fits into a recess W in the fore end of the body of the plane, and by passing a screw X through a slot in the stem V and the hole Z, the stop is fixed at any required degree of elevation, and the depth of the cut thus determined. When this tool is used as a filleting plane both the right- and left-side planes are employed, fixed at a distance from each other corresponding to the breadth of the fillet. To use it as a side fillister the left-side plane, Figs. 37 and 38, is alone used, with the stop inserted into the recess W. When used as a sash or back fillister the right-side plane, Figs. 35 and 36, is used, but with a slight modification in the figure of the fence represented in the side and top views, Figs. 41 and 42. To use the tool as a skewed-rabbet plane, the right-hand plane, with its chase P and the fence F, are laid aside, and the left-hand plane only employed. In this plane, the stock, the

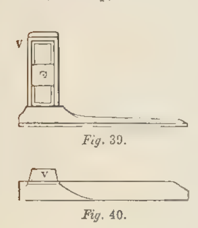


Fig. 39.

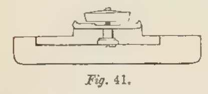


Fig. 40.

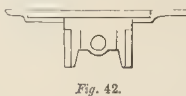


Fig. 41.

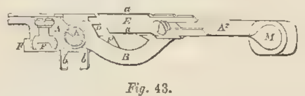


Fig. 42.

handle, and the body of the fence are of wood; the screws F F, the cushion of the travelling screw T, and the sliding nut O, are all of brass. All the other parts are of cast-iron, protected from corrosion by tinning or zincing. The fore and back parts, A^1 and A^2, are cast in one piece. The wood of the handle is not cut across the grain as usual, but with the fibres running in a direction at right angles with the body of the plane, whereby a considerable increase of strength is gained.

This patent also includes a *dado-grooving plane*, with which upwards of sixteen different sizes of work may be executed. Fig. 43 is an elevation,

Fig. 43.

and Fig. 44 a plan of this tool. A A^2 are the front and back parts of the body of the plane, which are connected together by the bow-piece B; D is a plate, cast in the same piece with the body, the lower edge of which forms the sole, and is about $\frac{1}{8}$th inch thick. E is the plane-iron, which is made at the upper end, and secured in its seat in the same way as the irons of the double-fillister plane, and terminates at the cutting edge in two projecting edges *a a*, which, when the iron is ground and set up, act as side cutters. A $\frac{3}{4}$-inch iron, adapted to this plane, is shown in Fig. 45, but the size may vary from $\frac{1}{8}$th inch to $\frac{1}{2}$ inch. F is a stop fence for regulating the depth of the groove; it is fixed and shifted by means of an upright arm F^2, which slides in a groove in a projecting part of the fore body of the plane, and a traversing nut and screw G H. I is a side fence, the under edge of which is all but flush with the sole of the plane: it has two bevel-edged prongs *b b*, which pass through a slot in the body of the plane, and by means of a traversing nut L, inserted between these prongs and a screw-pin K, the fence is fixed in its proper working position, which is when it is in a right line with the outer edge of the cutting iron Fig. 45. M, the handle, is the only part of this tool which is of wood. The materials and mode of putting together are the same as in the double fillister plane.

A quarter of a century has created a marvellous revolution in the wood-working trades, which before that period were essentially handicrafts. This revolution was commenced, in fact, before the century opened, but except in one or two special instances, the efforts then made did not produce much

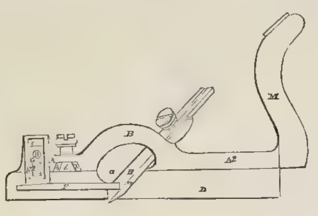


Fig. 44.

effect. In 1791 General Bentham patented a machine for planing wood, but it was little used. The principle was, however, applied to cutting shavings a foot wide for making the bodies of hat boxes. Another planing machine was patented by Mr. Bramah in 1802, a third by Mr. Norris, and a fourth by Messrs. Burnett and Burnett and Poyers; the last two are, we believe, still in use.

At about the date last mentioned Mr. Brunel, father of the late Sir I. Brunel, conceived the machinery for making ships' blocks, which, on the recommendation of General Bentham, above named, who was then Inspector-General of Naval Works, was adopted and set up at Portsmouth between 1804 and 1808. This machinery has been for nearly seventy years one of the wonders of Portsmouth, and includes many of the principles which have lately been developed in our general wood-working machinery. We borrow, by permission, from Professor Tomlinson's "Cyclopædia," already quoted, the following extracts and illustrations.

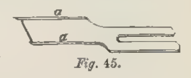


Fig. 45.

The blocks having been cut to the proper size by the saws, are placed in the *boring machine*, Fig. 46. This machine has an iron frame A A, with three legs, between which the block is introduced, and the screw B being forced down upon it, confines it to the proper place for the borers D E to

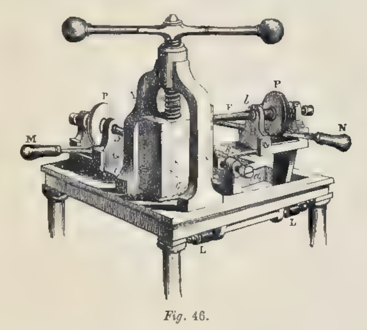


Fig. 46.

act upon it. The end of the screw B has a steel ring fitted upon it, the lower side of which is a sharp edge. When the screw is whirled round the balls at the end of its cross handle cause it to act as a fly-press, to stamp the impression on the end of the block. The exact position of the block is ascertained by a piece of metal (Fig. 47) fixed just beneath the point of the borer E. This piece of metal adjusts the position for the borer D, and its height is regulated by resting on the head of the screw *x*, which fastens the piece X down to the frame. The sides of the block are kept parallel by being applied against the heads of three screws, represented by dotted lines, in the double leg of A. The borer D bores the hole for the centre-pin; the borer E makes the holes for the commencement of the sheave-holes. The borers are of the same form as a carpenter's centre-bit, and each is screwed upon the end of a small mandrel, mounted in a lathe-frame G and H. These frames are fitted with sliders upon the edges of the flat bars *i k*, the former being secured to the frame, and the latter being fixed upon a frame of their own, moving on the centre screws L L, beneath the principal frame of the machine. In this way the borer E can be moved within certain limits, so as to bore holes in different positions, and these limits are determined by two screws, one at *a*, and the other on the opposite side. A projecting piece of metal from the under side

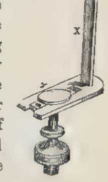


Fig. 47.

of the slider k, of the borer E, stops against the ends of these screws, to limit the excursion of the borer. The frames for both borers are brought up towards the block by the levers M N, which are centred on a pin at the opposite sides of the frame of the machine, and have oblong grooves through them, which receive screw-pins fixed into the frames G and H beneath the pulleys P P, which give motion to the spindles.

The block being applied with one of its sides against the three screws in the double leg, and resting on the screw x, is thrust up against the stop X, Fig. 47. The screw B is then brought down, which holds it fast, and the workman takes the handles M N and forces them towards the block. This brings the borers against it; and, as they are in rapid motion, they will bore as fast as they can be brought up to the work. This is the method of boring a single sheave block, when the screw-stops at a are screwed so far as to confine the frame k in a vertical position, and then its borer makes a hole through the centre of the block. For a double block the screws are withdrawn so far that when the frame is held against one screw its borer will be in the proper place for one hole, and when inclined to the other screw it will be in the proper place for the other hole; and this distance between the holes can of course be increased or diminished as required to suit thick or thin blocks. The borers can be unscrewed near the ends of their spindles at b, to put on one of a larger or smaller size. The points of the screw-centres at L, on which the frame of the borer E vibrates, can be put into different holes in the frame, so as to alter the difference of level between the two borers to suit blocks of different sizes; and the screw x is changed for one with a thicker head, or a washer is put upon its head. The stop X can be altered in position by sliding it farther from or nearer to the frame.

The block thus prepared by the boring machine is taken to the *mortising machine*, Fig. 48. This machine is moved by an endless band passing round a drum at A, screwed to a fly-wheel B. This drum turns an axis D, at the extreme end of which is a crank with a long rod extending from it up to a joint at a, by which it is connected with a frame E fitted between sliders b d, and guided by a cylindrical rod F sliding through a fixed collar. In this way the frame is moved up and down when the axis D revolves. To this frame the chisels are attached, and operate upon the block fixed at G in a carriage H, sliding horizontally in the frame of the machine. At e are three screws of the same size as the screw B of the boring machine, each furnished with a similar ring at the end. This ring enters the impression made by the boring machine, so as to fix the block in its proper position when the screw is turned. This forces the other end of the block against the cross-bar of the carriage, which has three steel circles fixed to it opposite the end of the screw e. Each of these rings includes two smaller rings with a sharp edge, and the pressure of the screw e forces the block against these rings and prints their figure in the wood. By this contrivance the block is held quite fast in the carriage while being mortised. Behind the carriage is a large double-wormed screw R, and this is received through a nut turning round in a fixed collar, supported by a bar across the frame. To this nut two wheels g h, are fixed: the former is a large ratchet-wheel; the latter a cog-wheel with a smaller one gearing with it, and fixed to the end of a long axis k furnished with a winch r. When this is turned round by hand the nut of the screw is also turned, and the carriage is moved slowly backwards and forwards. In this way the carriage is adjusted to the proper point for beginning the work. The gradual advance of the block to each cut of the chisel is produced by turning the ratchet-wheel g by the following contrivance. The axis D has an excentric circle I fixed upon it, which as it revolves acts upon a roller K, fixed in one arm of a bent lever; the other end of this arm has a rod m jointed to it, with a tooth in the middle which engages the teeth of the ratchet-wheel, and turns it round a tooth at a time as the rod moves backwards and forwards. The extreme end of this rod rests upon a lever n (except when being drawn over the sloping side of the tooth of the ratchet-wheel), the centre of which is a pin fixed in the vertical column of the frame. It is held up by a second lever o, supported on a cock screwed on the frame. The opposite end of this lever is made so heavy that its weight is sufficient to raise up n and m, so that the tooth of the latter will be too high to intercept the teeth of the ratchet-wheel in its motion. The heavy end of the lever is kept up by a piece of metal fastened to the side of the carriage, at p, by screws passing through oblong grooves, so that it can be attached at any part along the length of the carriage. By this means when the carriage has advanced as far as required, the loaded end of the lever o falls off the piece p, and disengages the rod m from the ratchet-wheel. The fly-wheel and drum which turn the machine are fitted on a cylindrical part of the axis, so as to move freely thereon when it is not required to work the

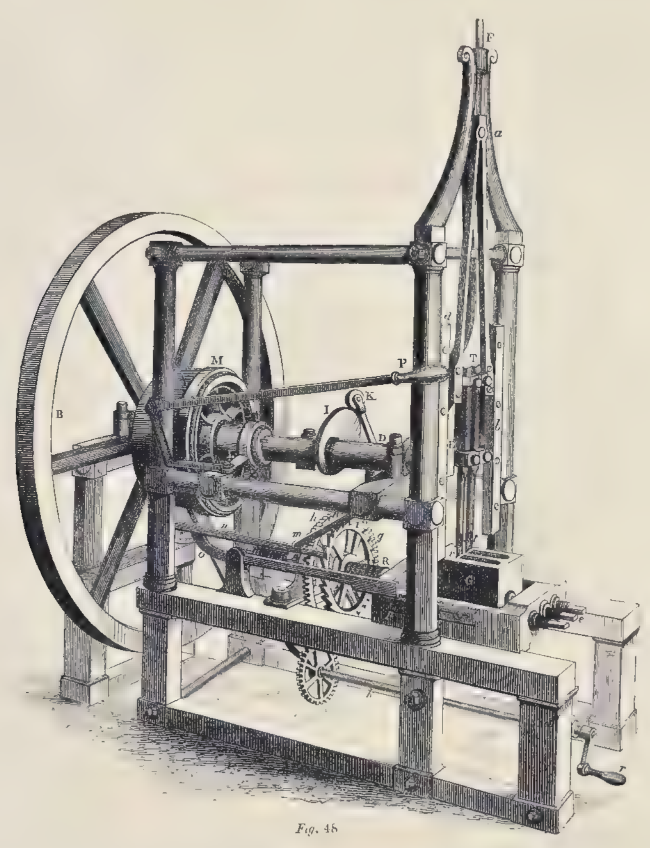


Fig. 48.

machine. A conical wheel S, with a hollow axis or tube centre-piece, is fitted upon the axis D so as to slide freely endwise, but is confined to revolve at the same time by fillets inserted in it. The end of the tube of the wheel S is formed into a circular groove, which is embraced by a forked lever L, centred in the opposite side of the frame. By moving the end of L towards the fly-wheel, the conical wheel S is thrust forward and jammed into the inside of the drum A; this exactly fits the wheel, and the friction caused by the contact of the two conical surfaces is sufficient to work the machine. But when the lever L is pulled away from the fly-wheel the conical wheel is drawn out from the rigger, and the fly-wheel detached from the axis, so as to revolve upon it freely without turning it.

In using this machine the block is applied with its screw mark to the end of one of the screws *e*. If a double block is to be mortised, as in Fig. 48, the centre screw is used; but if two single sheaves are to be fixed in, the two outer screws are used. By screwing it tight, the block is fixed between the double circle points before mentioned. To guide the block to its proper position, so that the hole bored for the commencement of the sheave hole shall be vertical, the block being fixed, the handle *r* is turned till the hole is brought beneath the sliding frame. The chisels are now adjusted. These are long square bars of steel T T, fastened to the frame by a clamp. The back of each chisel has a small piece of steel attached for thrusting out the chips which it cuts, to prevent the hole from being clogged up. It has also two small cutters or *scribers*, fixed perpendicular to its edge and projecting rather before it, so that in the descent of the chisel two small clefts are cut or scribed, which include the width of the chip to be cut out by the chisel in the succeeding stroke. By this means the mortise has its sides perfectly smooth. The back of the chisel is rounded to conform to the hole bored in the boring machine.

The clamp to which the chisels are attached passes behind the cross-bar of the frame, and the chisels being put exactly over the holes which are to become sheave-holes, are screwed fast by means of clamps. The machine is now put in motion by depressing the handle P, which is at the end of a

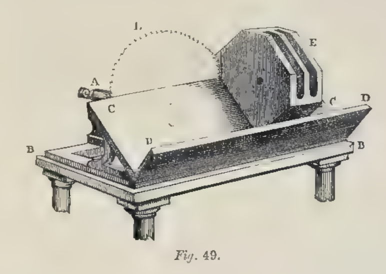


Fig. 49.

lever, the fulcrum of which is a pin fixed in the column of the frame at *s*, and a short arm gives action to the end of the lever L, so as to put the machine in motion. At the first descent of the chisels, they cut down through the whole depth of the holes previously bored, so as to give them a flat side when they rise up. The excentric circle I, moving the bent lever and rod *m*, turns the ratchet-wheel round on both and advances the block

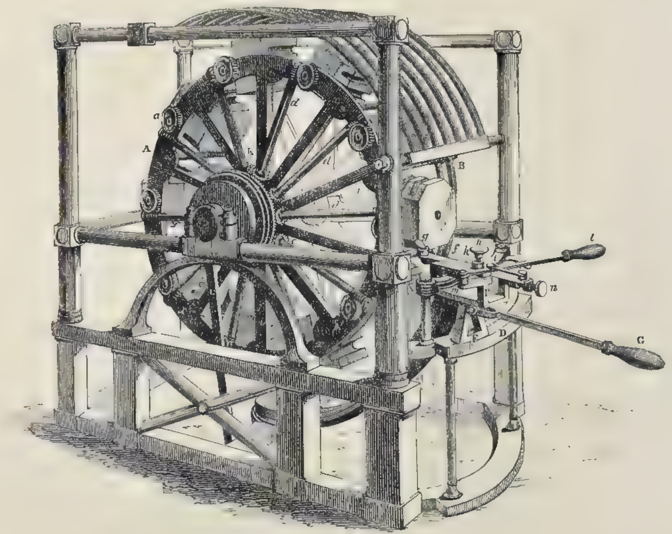


Fig. 50.

through a small space in the direction of the fly-wheel, so that the chisels in descending cut a fresh space, and in ascending the block advances. In this way the sheave-holes are rapidly cut, each chisel making from 110 to 150 strokes per minute, and cutting at every stroke a chip as thick as pasteboard with the utmost precision. When the mortising is completed, the loaded end of the lever *o* drops off the piece *p*, previously adjusted, and raises the rod *m*, so that the farther advance of the block is prevented. The attendant then raises the handle P, which stops the machine. The finished block is now removed and a fresh one put in: the handle *r* is screwed back to bring the block to the proper point, and the machine is set in motion as before. By an adjustment of the cross bar in the back of the carriage, the mortising machine is adapted to blocks of different sizes, and the frame E may have any number of chisels fixed to it, corresponding to the number of mortises required to be cut.

The corners of the block are next cut off by means of the *corner saw*, Fig. 49, which consists of a mandrel mounted in a frame A, carrying a circular saw L on its extremity. The frame of this mandrel is screwed down upon the frame B B, which is supported by four columns. C C D D is an inclined bench or trough, in which a block, as E, is laid, being supported on its edge by the plane C, and its end kept up to its position by the other part of the bench D. By sliding the block along this bench it is applied to the saw, which cuts off its four angles in succession, by applying its different sides to the trough. In the figure, two of the angles have been cut off and the third is just marked by the saw. By laying pieces of wood of different thickness against the plane D, so as to fill it up, the block is kept nearer to or farther from the saw, and in this way different sizes of blocks can be cut.

The blocks thus prepared have their outside surface formed to their true figure by means of the *shaping machine*, Fig. 50, the principal part of which is the chuck which holds the blocks. This consists of two equal wheels, A, B, mounted on the same axis, A being firmly fixed, while B slides upon it so as to render the space between them greater or less, as may be required for blocks of different lengths. This is effected by means of five bolts and nuts, the heads of the nuts being shown at *x*. Both wheels are divided into 10 equal parts. At each of these, on A, a short axis or mandrel is fitted through a projecting part of the rim of the wheel. On the outside of the wheel each of these mandrels has a small wheel *a* fixed upon its end. On the ends in the inside of the wheel the mandrels have each a short cross-bar fixed, sufficiently long to contain two steel rings, which are exactly the same size and distance apart as those in the mortising machine, which support the block. The wheel B has at each point opposite the mandrels *a*, a screw centre similar to the back centre of a lathe, but furnished at its point with a steel ring of the same size as that at the end of the screw of the boring machine. The blocks are held in between the wheels by putting the double point at one end of each block against the double rings at the end of one of the mandrels; and then, screwing the screw in the other wheel tight up, the block is confined between them. In this manner the chuck being filled with ten blocks, if they are turned round rapidly and a chisel or gouge be fixed for them to cut against, each will be formed to a

segment of the circle in which they move. This gouge is supported in a frame moving on a fixed rest D, which is curved to a circle whose centre is in the centre of the chuck. It is confined to move on this arch by a curved radial bar E, fitted to centre on the floor beneath the machine at one end, and having the other attached to the frame F, which supports the tool. This frame contains a slider *f*, moving in a groove, and at the end carrying the tool *g*, in a holder. The slider has an axis or spindle fitted perpendicularly in it at *h*. On the lower end of this is a roller, which applies itself against a curved piece of metal *i*, called a *shape*, fixed upon the framing. The roller is kept in contact with the shape by a lever centered at *k*, on the frame F, and connected by a short coupling iron with the slider *f*; so that when its handle *l* is pressed towards the machine, the roller is kept up to the shape. By means of a handle G, joined to the frame F, which carries the tool and all its apparatus, this frame can be moved along the rest D, being guided in its motion by the radial bar E. Now if the other handle *l* be at the same time pushed forward, the roller applies itself to the shape, and the gouge describes the same curvature as the shape. Below the first shape is a second *m*, and by a simple movement the roller can be depressed so as to roll in the second shape, and give the curvature of it to the tool instead of the upper one.

Supposing the ten blocks to be fixed as just described, the frame F of the gouge is turned to one end of the rest D, and the chuck put in rapid motion by a band round a pulley H, on its axis. The attendant, with the handle G in his right hand and *l* in his left, sweeps the frame along its rest by the handle G, while he keeps the roller in contact with the shape, by pressing the lever *l* towards the machine. In this movement, the gouge cuts to their proper curvature the faces of all the ten blocks which are farthest from the centre. When the frame has slowly traversed the whole length of its sweep, the outside faces of all the blocks are finished, and the machine is stopped by casting its movement off from the mill. But as it preserves a considerable velocity, this is checked by a steel spring at I, fixed at one end to the frame, and extending round a wheel fixed on the pulley H. The other end of this spring has a handle, which being pressed down, the curved part of the spring encloses the wheel and acts as a gripe. When the motion ceases the blocks are all turned one quarter round on the small mandrels A, by an endless screw on each of the wheels *a*. These screws are cut in the ends of as many spindles *d*, pointing towards the centre of the chuck. At the ends of those nearest the centre, each spindle has a small bevelled wheel *e* fixed upon it. There is also a large bevelled wheel K fitted upon the axis, between the wheel A and the pulley H, so as to slip freely round upon the axis, and when it is turned round, it will evidently turn all the wheels, spindles, screws, and mandrels at once, and thus turn all the blocks so as to bring another face outwards. While the chucks are turned round, the wheel is held fast, and the wheel K is stopped by a catch L, moving in a joint fixed on the ground. This wheel being detained, the attendant takes hold of the chuck by its rim and turns it round four times, and the bevelled and other wheels are so proportioned that those four times will make the blocks revolve exactly one quarter on their separate axes, so as to bring another side of each block outside. The machine is then set in motion as before, and the work is alternately stopped and carried on until all four sides are finished, the upper shape being employed to cut the third side in the same manner as the first, and for the second and fourth sides, the lower shape is used. By means of a screw *m*, the socket supporting the axis of the roller *h* can be moved along the slider, the effect of which is to project the tool *g* more or less beyond the shape, as may be required to cut larger or smaller blocks, thus the same shapes will serve for several different sizes.

This machine is surrounded by an iron cage (a portion of which is shown in Fig. 50) for the purpose of defending the workmen, in case the blocks, which are revolving with great velocity, should be loosened by the action of the tool and fly out by their centrifugal force.

As the blocks come from the shaping engine, they are taken to the *scoring engine*, which forms the groove round their longest diameters for the reception of their ropes or straps. This engine receives two blocks A, B, Fig. 51, each held between two small pillars *a*, fixed in a strong plate D, and pressed against the pillars by a screw *b*, which acts on a clamp *d*. Over the blocks a pair of circular planes or cutters, E E, are fixed on one spindle, which is turned by a pulley in the middle. This spindle is fitted in a frame F F, moving in centres at *e e*, so as to rise and fall when moved by a handle *f*. This brings the cutters down upon the blocks, and the depth to which they can cut is regulated by a curved shape *g*, fixed by screws upon the plate D between the blocks. Upon this rests a curved piece of metal *h*, fixed to the frame F, and enclosing but not touching the pulley. To admit the cutters to traverse the whole length of the blocks, the plate D is sustained between the points of two centres, which are furnished with screws at *l*. On depressing the handle L, the frame is inclined. At M, a lever weighted at the end counterbalances the weight of the blocks and plate D, all which are above the centre on which they move. The frame F has also a counterpoise to balance the cutters, &c. The cutters E are circular wheels of brass with round edges; each has two notches in its circumference at opposite sides, and in these notches chisels fixed by screws project beyond the rim of the wheel.

In using this machine, the block is pressed between the two pins *a*, and the clamp *d* is screwed up against it. This clamp has two claws, each furnished with a ring, which enters the double points before mentioned in the end of the block. The blocks being properly mounted, the attendant presses the cutters E E by means of the handle *f* down upon the blocks, depressing them between their pins until their descent is stopped by the piece *h* resting on the shape *g*. He then turns the screws *b b* to fix the blocks tight, and the cutters being put in motion will cut the scores, which, by the adjustment previously made, will be of no depth at the pin-hole;

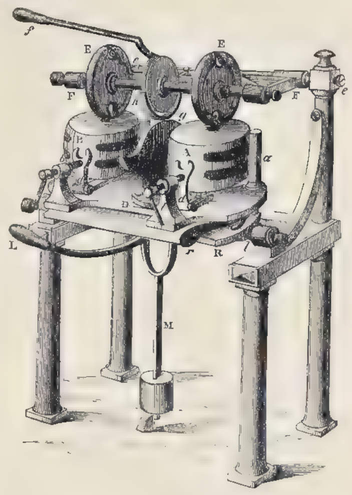


Fig 51.

but, by depressing the handle L so as to incline the blocks, and keeping the cutters down upon their shape *g* by the handle *f*, they will cut any depth towards the ends of the blocks which the shape *g* admits. In this way one quarter of the score is formed; the other is done by turning both blocks together half round, by the following contrivance:—The centres *l* are not fitted into the plate D, but into a frame at R beneath the plate, which is connected with it by a centre-pin exactly midway between the two blocks A, B. A spring catch, the end of which is seen at *r*, confines them together; when this catch is pressed back, the plate D can be turned about upon its centre-pin so as to change the blocks end for end, and bring the unscored quarters, or those over the clamps, beneath the cutters; the workman, taking the handles *f* and L one in each hand, and pressing them down, cuts out the second quarter. This might have been done by simply lifting up the handle L; in which case, however, the cutter would have struck against the grain of the wood; but by reversing the blocks, it always cuts clean and smooth in the direction of the grain. The third and fourth quarters of the score are cut by turning the other sides of the blocks upwards and repeating the above operations. The shape *g* can be shifted for different sizes and curves of blocks.

There are several auxiliary machines, which perform minor operations. The machines number forty-four in all, and form three series, making blocks of three sizes, and some extra-sized up to blocks 4½ feet long with four sheaves—which, however, are partly made by hand. The three series of machines are capable of producing 200 large, 520 medium-sized, and 700 small blocks a-day. It will give some idea of the value of machinery of this class, to state that the saving to the Government per annum by Mr. Brunel's machinery was £16,600 odd, which sum was paid to him by way of remuneration in addition to a guinea a-day for nearly six years, during which time he was engaged in completing the machinery. The making of the machines was entrusted to Messrs. Maudslay and Co., of London, and so well was it executed that a duplicate set, which the Government had made and kept in constant readiness to work, in case that at Portsmouth should at any time break down, has, we believe, never been used. This again is a proof, if such were necessary, that thorough good work is the truly economical.

"Necessity is the mother of invention" is an old and true saying, and it was never more completely proved than in the case of wood-working machinery. The Great Exhibition, which went off eventually with so much èclat, was at one moment in imminent danger of failure, or great delay, on account of the impossibility of getting the enormous amount of woodwork executed within the allotted time. Paxton's admirable idea of applying the principle of the formation of a building by the multiplication of a very simple element, could not reduce the quantity of wood to be worked, and

how to make some twenty miles of gutter and ten times that amount of sash bar was the problem to be solved. There was nothing for it but to take advantage of such machines for the sawing and planing of wood as were then in existence, and to supplement them with others specially adapted to the necessities of the case; this was carried out with perfect success.

The hand-rails for the galleries and staircases were made of Honduras mahogany, and were turned out by means of the machine shown in Fig. 52. The mahogany was supplied in slabs of the proper thickness,

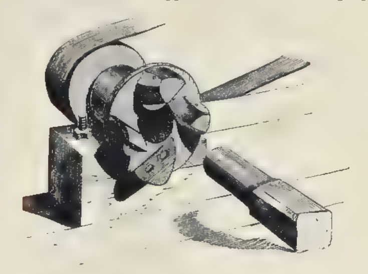


Fig. 52.

and these were cut up by means of circular saws into lengths of a square section; the angles were then bevelled off, and the rough length of mahogany was rounded at the hand-rail cutting machine. This consists essentially of a hollow cast-iron cylinder driven by a strap passing round it. Four cutters are fixed at one end of this cylinder, as shown in Fig. 52, so that a piece of wood passing between them and through the cylinder, as it revolves, is rounded off cleanly and smoothly, requiring only a little sand-paper and French polish to finish it. The wooden rail is passed up to the cutters along a groove, and opposite each end of the revolving cylinder springs are fixed, which prevent the rail from shifting its position. In advance of the cutters are pressure-rollers furnished with teeth, and these by their revolution seize upon a piece of mahogany and force it forward against the cutters. About thirty lengths of hand-rail, each of 24 feet, were thus completed in a day.

The Paxton gutters or rafters which spanned the space between the girders were formed with great rapidity by effective machinery arranged by Mr. E. A. Cowper. The pieces of timber intended to form the gutters were sawn into lengths of 24 feet long, 6 inches deep, and 5 inches thick. They were then planed on the four sides at Furness' planing machine. In this machine, cutters attached to the ends of an arm revolve with great rapidity in a horizontal plane: three widths of timber are wedged up in a frame traversing on rails, and as this is passed under the revolving cutters the upper surface is planed off, the timber being held down upon the frame by a large iron disc.

On leaving the planing machine these quarter baulks were passed on to the gutter-cutting machine, the details of which are given in the following figures. Fig. 53 is a side view of a cast-iron block, to which steel cutters, C C, are attached by bolts and nuts, B B. Four such blocks required to form the gutter are fixed to four spindles, and by the action of drums upon them are set in rapid motion by bands. A piece of timber exposed to the action of these cutters must evidently be scooped out into the form of the cutters attached to each block, and by varying the form of the cutters any variety of section can be given to the timbers. In the present case the first set of cutters roughly hollowed out the larger groove, as in section 1, Fig. 54; the two next sets of cutters were counterparts, and formed the same section in opposite directions; these

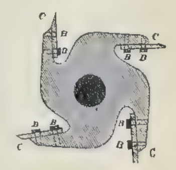


Fig. 53.

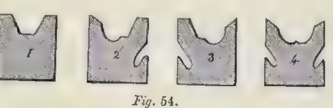


Fig. 54.

cutters being set at an inclination to the upright of about 45°, one to the right and the other to the left, each hollowed out one of the small side

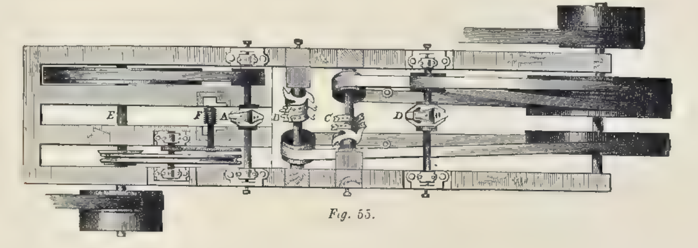


Fig. 55.

grooves, and one side of the larger gutter, leaving the section as in 2 and 3. No. 4 is the section after passing through both. The action of the machine will be seen by referring to Figs. 55 and 56. The piece of timber is placed upon the roller E, and pushed on until it comes in contact with the roller F,

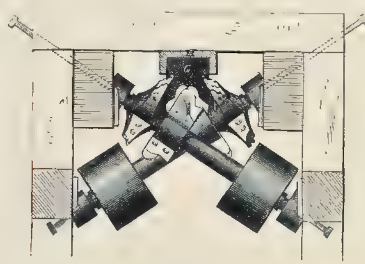


Fig. 56.

furnished with projecting points, which seize it and propel it forward, so as to bring it under the action of the set of cutters marked A; then passing onward to B it is operated on by a second set; at C by a third set; and in passing through D the gutter is completed. The section, Fig. 56, shows the angles at which the cast-iron blocks holding the cutters revolve. G is the gutter kept in its place by the holdfast H. By this machine 8 feet of gutter was made per minute, and the 110,000 feet, or nearly 20 miles, required for the building completed in two months.

As the gutters were delivered at the works they were carefully examined, and the defective rejected; they were then cut down to the exact length, so as to fit in their places. For this purpose each gutter was fixed in a framework, and bent to the same curve which it would have when fixed, in order to cut off the ends vertically. At one end of this framework a circular saw 20 inches in diameter was hung with a pulley and balance weight, so as to be capable of being moved up and down by a lever. The gutter was fixed in its frame by hinged gauge-plates, and the end was cut off by bringing down the circular saw. Another operation was also performed at the same time. In the centre of the circular saw two cutters were so arranged that, when brought down upon the end of the gutter, they cut out a semicircular notch, so that when the ends of two gutters were placed together, a circular hole was left for the passage of the water into the main gutter. When one end of the gutter was thus operated on the gauge-plate was taken off, the timber



Fig. 57.

swung round on a pivot or crutch in the centre, and the process repeated, the whole operation occupying about two minutes.

The solid gutter was then taken by the carpenter, who fixed at each end on the under side a small cast-iron shoe, and two struts 9 inches long, so as to divide the length into three equal parts; the struts were spread out at top so as to present a large surface of pressure against the under side of the gutter, and tenons projecting upwards fitted into mortises cut in the timber. The lower ends of the struts were so formed as to give them a firm hold upon a wrought-iron rod thirteen-sixteenths of an inch in diameter, which was passed under them and through the shoes, where it was screwed up with nuts, and the struts pressing upwards against the timber gave the

gutter a camber or rise in its whole length of $2\frac{1}{2}$ inches; twenty-seven notches for the reception of the sash-bars were then marked with a template, and cut out on each edge of the upper side of the gutter. A small cast-iron plate was next fitted on the under side at each end, and the gutter was then complete and ready for fixing. The under trussing of these gutters or rafters increased their strength considerably, so that a weight of $1\frac{1}{2}$ ton was required to break one.

Fig. 58.

The Paxton gutters followed the direction of the length of the building: at right angles to these, and supported by the roof girders, were the box gutters, C, Fig. 59, which received the drainage-water collected by the Paxton gutters, and discharged it down the hollow columns into the drains.

We come next to speak of the sash-bars. When it is considered that about 200 miles of sash-bars were required for the roof, it may readily be supposed that self-acting machinery was alone adequate to their production. Indeed, if the contractors had had to rely only on the productive powers of workmen, however skilful and industrious, the Palace of Glass could not have been produced; but when such powerful machines as those which we have described work with untiring energy night and day, and supply the place of thousands of mechanics, great and useful undertakings, which would otherwise be impracticable, are not only rendered possible, but comparatively easy. It is also interesting to remark that such machines, which seem to demolish labour, actually increase it to an incalculable extent; 2,000 men were employed at good wages within the building for some months, and many thousand men were working night and day for the same or a longer period in preparing the iron, the glass, the timber, &c., to say nothing of the vast impulse given to the industry of the whole world by this truly great Exhibition.

Fig. 59.

The machine for shaping the sash-bars was a modification by Mr. Birch of one invented by Mr. Paxton. In Mr. Birch's machine revolving cutters are substituted for saws, thus getting over any difficulties respecting the grain of the wood; and by the addition of a second set of cutters, a plank passed between them is worked upon its upper and under surfaces at the same time. A cast-iron block with cutters attached to it, Fig. 60, is moved upon an axis A, Fig. 60. As soon as the plank presented by the feed-rollers has been operated on by these cutters, it is carried on by the roller C, and subjected to the action of circular saws of varying diameters, the smaller of which cut just deep enough to form the groove for the glass, while the larger pass completely through the plank, and divide it into four finished sash-bars. The sections, Figs. 62 and 63, show the sash-bars for the vertical lights; the shaded part being that which is removed by the machine. Figs. 64 and 65 show the method of cutting the sash-bars for the roof. These variations in form are produced by varying the cutters attached to the block, Fig. 60.

Fig. 60.

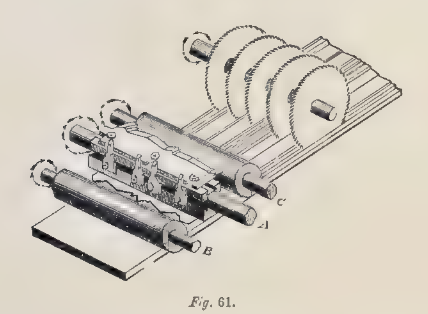


Fig. 61.

The sash-bars were finished at the building, and made to fit the notches prepared in the ridges and gutters. Thirty bars were first placed together in a horizontal traversing frame, on a saw-table, on each side of

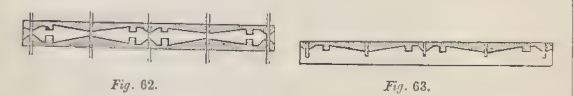


Fig. 62. *Fig.* 63.

which were circular saws, fixed at a distance from each other equal to the required length of the sash-bars; the frame was then moved forward against the saws, and both ends of the whole set were thus cut off; at the same time a cut was made at one end half-way through the bar, in order to form a shoulder against the gutter. The bars were then removed to another bench, where the bar was bevelled and the shoulder formed by means of a small instrument, consisting of a handle with two projecting jaws fitting into the ends of the glass grooves of the bars; between these was a small blade, which, being pressed down, cut out the shoulder which had been



Fig. 64. *Fig.* 65.

sawn through in the other direction, and another blade was placed at the proper angle to remove the bevelled piece at the end of the bar. A hole was next drilled at each end, for the purpose of nailing the bars down on the gutter and ridge; and to ensure the holes being all drilled at the same angle, the following method was adopted:—On one side of the horizontal bench was a set of 4-inch driving pulleys, furnished with horizontal drills projecting to the other side of the bench; a wooden traversing plate, placed opposite each drill, and working towards it, received one end of the sash-bar, while the other rested in an inclined position against a wooden rail placed above the pulleys, and furnished with as many sinkings therein as there were drills. The traversing plate pushed forward the sash-bar to be perforated by the drill; the plate was then drawn back, and the same operation repeated with the other end of the bar, which was then ready for fixing. The ordinary sash-bar is shown in section Fig. 67. One out of every nine of the sash-bars was made stouter than the rest, for the purpose of fixing the ridge previous to glazing. The stouter bar, shown in section Fig. 66, 2 inches by $1\frac{1}{2}$ inches, is grooved for glass on both sides, and notched down: being set at a pitch of $2\frac{1}{2}$ to 1, and fixed to a ridge 3 inches by 3 inches, also grooved for glass on both sides. After the ridges were cut to the exact length, two holes were drilled at each end to receive the dowells for connecting it with the adjoining length.



Figs. 66, 67.

In painting the sash-bars, labour was greatly abridged by mechanical contrivance. A number of brushes were arranged in a frame at right angles to each other, in such a manner that their bristles would just allow a sash-bar to pass. A number of sash-bars were immersed in a trough full of colour, and one of them being lifted from it loaded with paint, and presented to an opening at one end of the series of brushes, was passed through them, and the superfluous paint removed, when the bar appeared at the other side neatly painted.

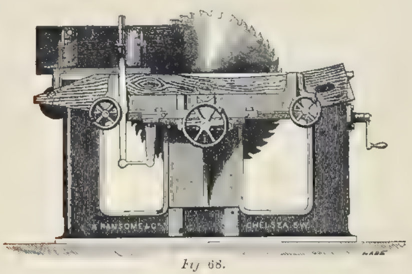
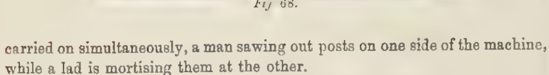
The execution of such a vast amount of woodwork as composed the Great Exhibition building naturally attracted great attention, and from that moment the application of machinery to carpenters' and joiners' work was assured. At the present moment almost every operation in woodwork, from the sawing up of the tree to the cutting of dove-tails for the finest cabinet work, is performed by means of machinery, and this has naturally given rise to the establishment of many large works where the elements of the carpenters', joiners', and cabinet-makers' work are prepared and sold; as, for instance, flooring boards in hard or soft wood planed and tongued or dowelled, all ready to be laid down; *parquet* for flooring in the continental style of plain oak or in patterns; panels of inlaid woods in artistic designs; mouldings, architraves, skirtings, of any profile; and even doors, windows, partitions, and wainscoting all ready for fixing.

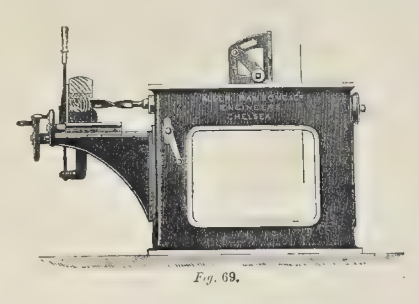
We shall now give an account of some of the most improved machinery at present in use for the purposes above mentioned.

Since the period of which we have been speaking, immense strides have been made in wood-working machinery. Many of our readers will have seen these interesting machines at work at the exhibitions, and for the benefit of those who have not we shall attempt to describe some of the most important, with the aid of engravings for which we are indebted to Messrs. A. Ransome & Co. of Chelsea, who have brought machinery of this nature to a high degree of perfection.

In order, if possible, to convey a clear idea of the compound machines now in use, we shall commence with the most simple, the "estate carpenter," as it is called, see Figs. 68 and 69, which is intended expressly for general jobbing work upon farms or estates, such as sawing out, mortising and pointing posts and rails, ripping out fencing, cross-cutting firewood, sawing square blocks for paving, &c. It consists of a strong cast-iron framing with a planed table, which forms a saw-bench on one side capable of working saws up to 30 inches in diameter; while at the other side is a mortising and boring apparatus, which will make mortises in any kind of wood up to 2 inches wide, and of any length and depth, with great ease and rapidity. The driving pulley, which is fixed between the bearings, is entirely below the bench, so as to allow of timber of any length being cross-cut by the saw. A cast-iron sliding plate for cross-cutting is supplied with the machine, which works in a planed V-groove formed at the top of the

table, in a line parallel with the path of the saw: this ensures a perfectly true and square cut, and prevents any cross strain on the saw. This plate is provided with a cramp lever for holding crooked pieces, such as boughs of trees, securely when being cross-cut. The fence is adjustable to cant at any angle, and works on a round bar at the end of the table, so that it can be turned over the end of the machine and leave the top clear for cross-cutting. The mortising table has a rising and falling motion of considerable range, so as to enable the machine to mortise large posts up to 8 or 9 inches square; and it also is furnished with a peculiar cramping arrangement. When used for boring, an auger is substituted for the mortise tool, and the slide which carries the wood is worked by hand. Both sawing and mortising can be carried on simultaneously, a man sawing out posts on one side of the machine, while a lad is mortising them at the other.



Fig. 68.


Fig. 69.

Every operation in carpentry almost has now a machine of its own, but for small shops there are machines known as "general or universal joiners," which perform all kinds of work exceedingly well, provided they are well designed and manufactured; if not most carefully made, they are literally worthless, and lead to severe disappointment. General joiners cost less than several separate machines, but some of them are far too complicated.

The "original general joiner," represented by Figs. 70 and 71, is well known in the building trade. It was originally designed to be fixed in a joiner's shop, to be used for ripping out, tenoning, mortising, grooving, rabbeting, moulding, &c.; but the variety of work of which it is capable, and the readiness with which it can be changed from one class of work to another, caused it to be largely used in railway carriage shops, pianoforte and cabinet factories, pattern shops, and on estates. Each of the tables has a separate rising and falling motion, so that a man can be sawing, grooving, or tenoning at one side of the machine, while a lad is mortising or boring at the other: and when so worked, it will do as much as fifteen joiners. Tenons are formed by passing the piece, which is fixed in a slide, in a vertical position, over two saws placed side by side on the spindle, and thus both the deep cuts are formed at one time; the shoulders are afterwards cross-cut by passing the piece, in a horizontal position, over a small saw in the bench, the wood being held upon a light sliding plate working in a groove formed in the bench, to insure a perfectly straight cut. For grooving, a "drunken saw" is employed, being fixed upon the saw spindle at the proper angle to form a groove of the desired width, and the table is raised so as to let the saw appear only the depth of the groove above its surface. Rabbeting, grooving, tongueing, moulding, and chamfering are all done by cutters of various forms, screwed to a block which fixes on the saw spindle. Mortising and boring are carried on at the other side of the machine, the auger or mortise tool being screwed into the end of the saw spindle; the wood to be mortised is cramped upon a planed sliding plate, which has a lateral motion worked by a hand lever, and also a transverse motion worked

Fig. 70.

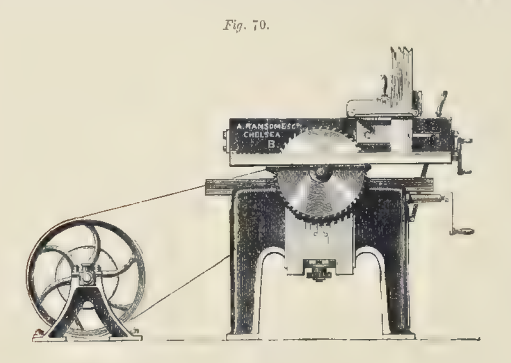
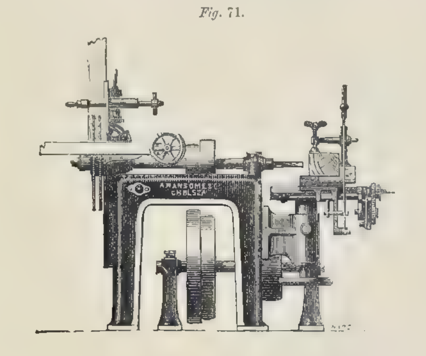
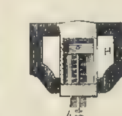
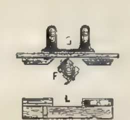
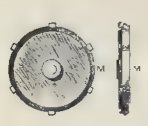


Fig. 71.





by a screw. By the combination of these two motions, which are worked simultaneously by the operator, the tool works out a mortise of any required size, the length of the mortise being determined by adjustable stops, which govern the range of the lever. The details engraved beneath the figures represent:—A, frame to be used when ripping; D, cross-cut plate; H, wedge-cutting apparatus; G, spring for holding mouldings over the cutter-block; L, other view of G; E, drunken saw; I, filling-in plate for moulding; M, planing disc.

The above-named machine was invented as far back as 1858, by Mr. Whines, but it has been somewhat modified, and to a great extent superseded by later inventions. We will now speak of one of the best general machines, that of Messrs. Ransome & Co., represented by the two figures 72 and 73. Its capabilities may be thus described:—It works saws up to twenty-four inches in diameter; cross-cuts stuff of any length up to four inches thick; it will plane, groove, tongue, edge, thickness and head boards up to nine inches wide, at a single operation; strike single or double mouldings of any pattern, worked perfectly true on all four sides, and cut circular mouldings up to three inches in width; make grooves up to inch and a half wide; cut single or double tenons, of various widths, apart, scribing the shoulders at the same operation; make mortises from one eighth of an inch to one inch and a half wide, of any length, and in any kind of wood; and bore holes up to two inches in diameter. The various parts of this machine have evidently been studied with great care, and they are admirably executed of the best materials. The mouldings and other work effected by it under our own eyes were admirably true, without the slightest trembling or any other fault. The study of such a

machine is a valuable lesson in mechanical adaptation. Of course such a machine as this is an important affair: it weighs about a ton and a half, and requires an eight-horse power steam-engine to drive it efficiently. The saw spindle runs at the rate of 1,500 revolutions, and the planing or moulding cutters at 4,500 per minute.

We should have been glad to have given some other of the principal machines for working wood, such as planing machines with rotating cutter, with fixed cutters like plane irons, and planing and moulding machines with cutters fixed to revolving blocks. But we have already almost exceeded our space. Messrs. Ransome & Co. have introduced a very useful innovation in the form of a strong double blast of air which carries off sawdust, chips, and even small pieces of wood from beneath the machines in action and depositing all in a chamber close to the steam furnace. This arrangement cannot be applied to all machinery; but where it can, it is valuable in preventing foreign matters getting into the working parts, and a consequent extra expenditure in lubrication.

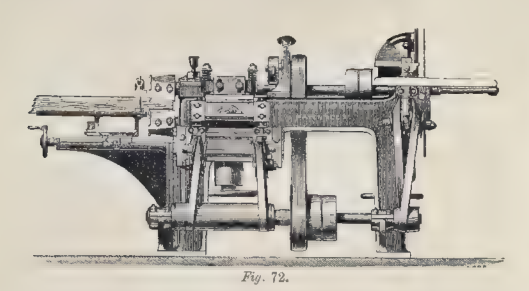


Fig. 72.

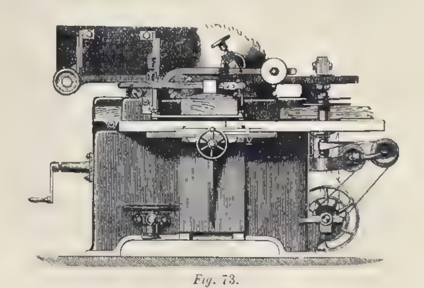


Fig. 73.

There are one or two special machines which we must not pass over. The most interesting, perhaps, are those for dovetailing—the first of which was sent from the United States to the Paris Exhibition of 1867, and excited much attention. Dovetailing is so extremely tedious an operation that when once the idea of performing it by machine arose, it excited mechanical genius all over the world. We present two of the best-known machines. First, a machine designed by Mr. Ramsbottom, of Crewe (Fig. 74), for the purpose of dovetailing the tool-chests, &c., for locomotives, made at the London and North-Western Railway Co.'s works; but it is equally applicable for all kinds and sizes of packing-cases and other similar work. The cutter spindle revolves at a very high speed in a long socket fitted with a self-lubricating arrangement, by which it is kept constantly supplied with oil. This socket works in a slide forming part of a circular plate which is attached to the main standard of the machine, and so arranged that it is kept at right angles to the table while cutting the dovetail, and is set to the required angle when used for cutting the pins. The cutter-slide is brought down to its work by means of a counterbalanced treadle, as shown in the engraving. The boards are held in their places by a screw cramp which effectually prevents them from shifting when under the action of the cutters. The sliding table is made to travel on the fixed bed by means of a screw worked by a handle at one end, fixed in a convenient position for the operator; and by the use of change-wheels dovetails of various sizes and pitches can be cut. This machine will dovetail pieces up to 3 feet wide, and of any length. The next engraving, Fig. 75, represents a dovetailing machine for packing-cases, &c., made by Messrs. Ransome & Co., which forms the dovetails by means of a series of revolving cutters. The whole machine stands upon a strong column, and is driven from an overhead counter-shaft. The cutter spindles are fitted with cutters at each end, and the work is fixed upon planed tables, each having a separate rising and falling motion worked by a foot-lever. The tables, being one at each end of the machine, can be worked separately as two distinct machines, and two lads, it is said, will easily dovetail thirty-three boxes, averaging 18 inches square, in an hour. The cutters are of the most simple kind, and a provision is made to compensate for wear. All the parts are very strong, and the great simplicity of the machine makes it peculiarly suitable for use in India and other places where native labour only is available.

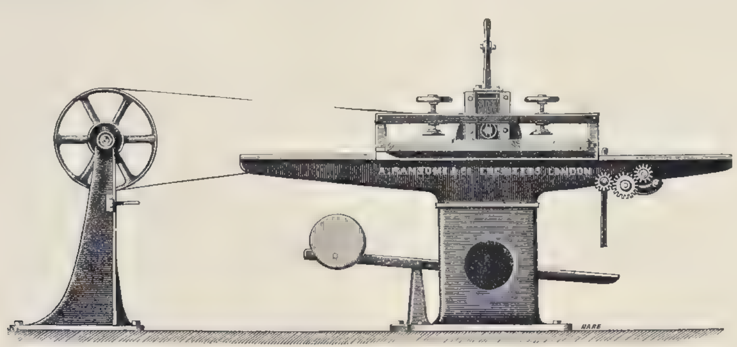


Fig. 74.

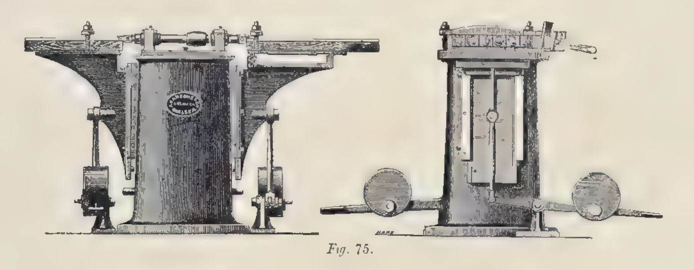


Fig. 75.

We do not pretend for a moment to suppose that the above description of these curious machines is sufficient to make them thoroughly understood by the uninitiated; but machinists will, we trust, find an interest in it, and students an incentive to further inquiry.

A description of mechanical piercing saws will be found in the treatise on "Fret Work, &c.;" and of a copying lathe under "Turning."

The Americans exhibit much talent for labour-saving machinery, and we avail ourselves of the courtesy of the proprietors of the *Engineer* to

give representations of some of the most remarkable of novelties in the way of wood-working machinery that appeared at the late Philadelphia Exhibition. The engravings which we introduce here represent three different machines which have been used with more or less success previously; first, the simple moulding machine, which consists of a shaped cutter, as seen at Fig. 76, coming up through an orifice in an iron slab and revolving with considerable rapidity, by means of which the edges of table-tops or other pieces are rapidly moulded; secondly, a machine for carving irregular figures by means of iron patterns which guide the motions of the cutter—two of these guides are shown in Fig. 77; and lastly, a machine for the extremely difficult operation of dovetailing. At Philadelphia there were several





Fig. 76.

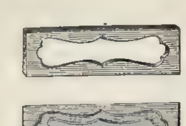


Fig. 77.

machines for this purpose, and one which combined dovetailing with carving and moulding, exhibited by Mr. Boult. Fig. 78 presents a general view of this machine, Figs. 79 and 80 examples of the dovetailing produced and the cutter employed. The correspondent of the *Engineer* says: "Boult's carving, moulding, panelling, and dovetailing machine is a remarkably ingenious contrivance for performing all sorts of operations on one machine, and it is very readily adjusted, to execute this great variety of work. When used for edge moulding and shaping, the upper arm is not required, the work being performed by the cutter which rises through the table. When surface moulding and panelling are required, the work is held by means of a disc screwed down through the upper arm, and the rapidity with which a copy of a moulded sunk panel can be executed by this machine is wonderful. By driving cutters from the upper arm the most delicate scroll, basket, or fretwork can be executed, and with the dovetailing attachment, excellent dovetails can be produced, cutting the side and front of a drawer or chest at the same time." Many improvements were shown in boring, planing, and other machines. A remarkable circumstance also is the automatic powers conferred upon much of the machinery. On this head a correspondent of the *Times* writes:—

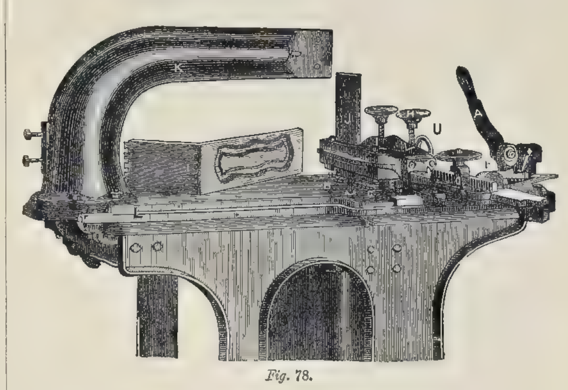
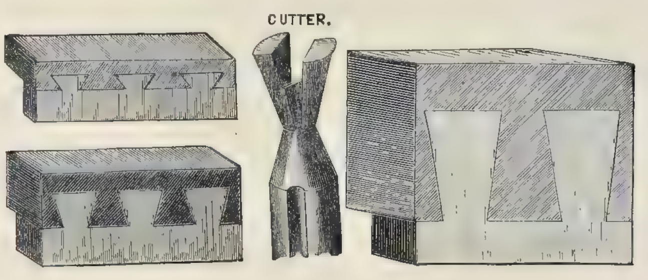


Fig. 78.

"As an example, a remarkably clever machine was in daily operation, pressing the exterior surface of wooden hoops for casks. The hazel sticks or rods, with all their crooks and lumps, were fed into the machine, and passed instantly through it. The province of the machine is to feel their exterior form, and then to dress the outer surface in conformity



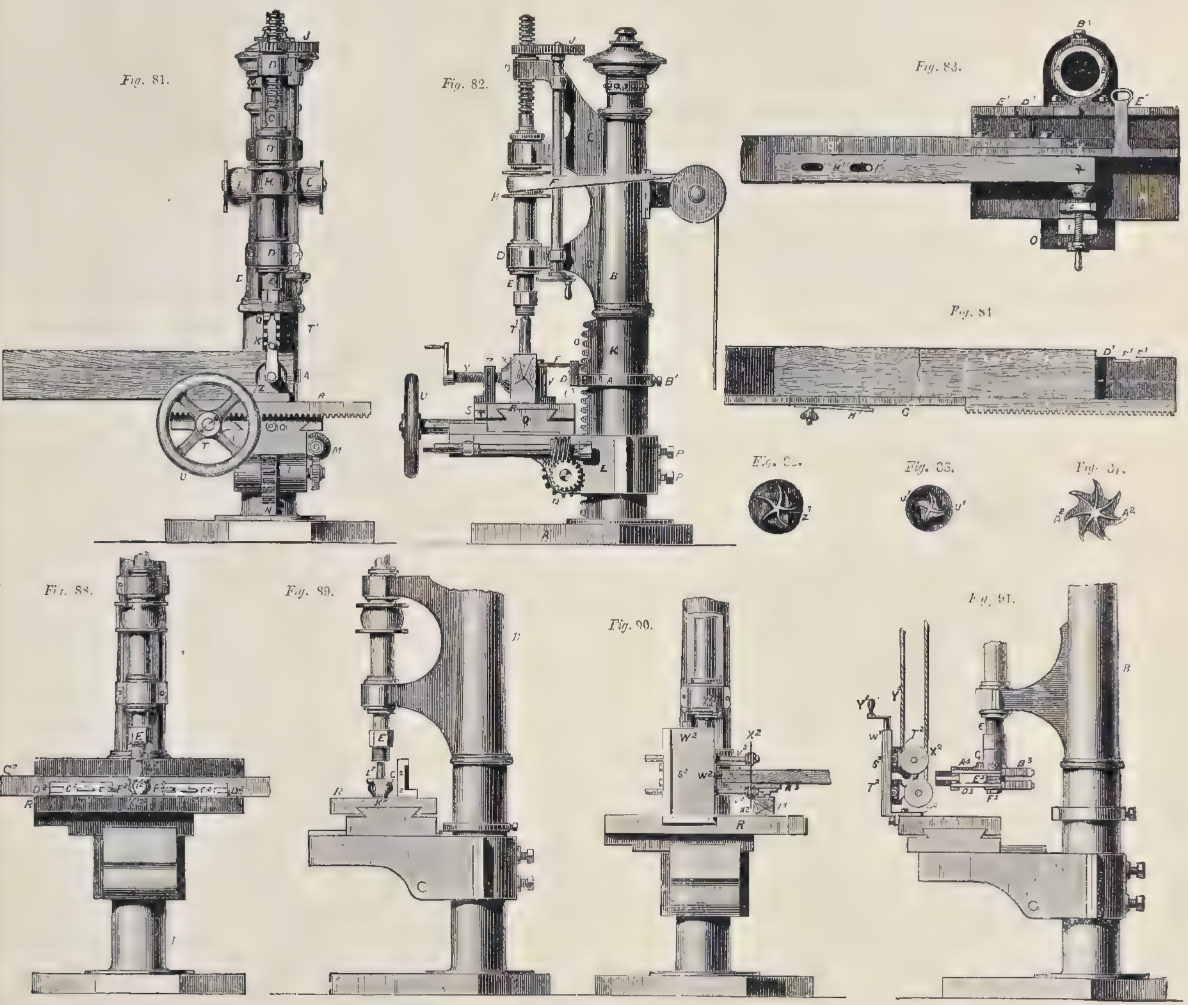
Figs. 79, 80.

therewith, but not to disturb the fibre. This is a sort of duty that might be supposed to require judgment to do it properly. The necessary intelligence is embodied in the machine, and the work is done to perfection. It was also to be observed that machines are having intrusted to them the duty of sharpening their own cutting instruments when they become blunted."

We have seen similar improvements in other kinds of machines of late—for instance, the employment of an iron finger and thumb to feel hemp or other yarn as it passed into a machine, and, in case of undue thickness appearing, to stop the machine by casting off the driving belt.

The following series of engravings represent a machine, invented by Mr. Richard Carter, of Bradford, which supplies a good example of many machines in use for mortising, tenoning, housing staircase strings, striking mouldings suitable for doors, small architraves, and other work. The mortising, &c., is performed without the work being previously set out by a skilled man. It can be used for dowelling purposes, chairs, &c., by cabinet makers, and it will cut ornamental open work of any pattern, however irregular, for the eaves of houses. The machine consists of a stout iron pillar, bolted to an iron base. Projecting from the pillar are three iron arms which support the cutting machinery, and at the back is an iron bracket, bolted to the pillar, to carry the wheels for pulleys. In front of the machine is an iron table and framework bolted on to the base. The table travels, and can be raised or depressed according to the thickness of the material operated on, a projecting lever locking the table when the chisels and cutters are in motion. In a minute a door can be mortised ready for a lock, an operation which would take a workman an hour. The chisel for moulding and rabbeting circular-headed sashes cuts both ways, according to the grain of the wood, springs keeping the moulding in proper position. In tenoning, two small circular saws driven by an endless cord cut the shoulders clean. The saws can be raised and lowered by means of a lever and screw for the required size of a tenon, and they move sideways for long and short shoulders, and for solid, moulded, or beaded framing. Figs. 81 and 82 are respectively side and front elevations of the machine ready for mortising; Figs. 83 and 84 show the arrangement for mortising; Figs. 85, 86, and 87 show cutters, and 88, 89 show one side and front elevation of the machine as a moulder, with cutter in position; Fig. 90 is a side view as a tenoning machine, and Fig. 91 is a front elevation of the same. On a foundation plate A is fitted a pillar B, having brackets C formed or fitted on it; these brackets carry the bearers D of the revolving spindle E, to which motion is imparted by means of the belt F passing over the pulleys G, H, and I; the spindle E is regulated and raised or lowered by the spur gear J, which actuates a nut on a screw formed on the spindle, in which is fitted the mortising bit. The bottom part K of the pillar B is turned true, and on it is fitted a bracket L, so arranged that it can be swung round the pillar, so that the one arrangement will serve for mortising door locks. The bracket L can be raised or lowered by means of the worm gear M, which actuates the pinion N, gearing into the rack O, allowing the different heights for mortising to be obtained. The bracket L can be swung round the pillar B, and it can be fixed in any required position by the screws P; on the bracket L are fitted ordinary longitudinal and transverse slides Q, and on the top slide is fitted a table R made to slide thereon. Underneath and on the side of the table R is fitted a rack S actuated by a pinion T, and worked by the hand wheel U; this wheel is made so that it may be removed when the table is once fixed to the required position. The table R is fitted with a movable fence V working in slides W. The wood to be fixed for mortising is held against the fence or stop V, by the

cramping piece X, actuated by the screw Y working through the bearer Z; this bearer is fitted with screws, and can be removed when not required. On the part K of the pillar B is fitted a ring A, B (Figs. 82, 83), made so that it can be raised or lowered, and fitted with a screw B^1 for fixing it to any required position; the ring is formed with a projecting piece C^1, to which is bolted a guide D^1 made with openings E^1, in which works a guide lever F^1 fitted on the fence V. The lever F^1 travels with the table R, and on and in the opening E^1, which is made equal in travel to the length of the mortise hole to be cut. On the table R, and bolted to the fence V, is a wooden guide frame G^1, on which is placed the wood to be operated on; and on the under side of the frame G^1 are fitted springs H^1 having studs I^1 which pass through openings made in the bottom of the frame G^1, and enter the mortise holes which have first been cut, acting as guides for cutting the other mortise holes, and doing away with the necessity of setting out all the holes to be mortised, and in addition making each piece of wood mortised mathematically true. On the side of the table R is fitted a bracket, in which works the end of a screw, which works through a swivel lug fitted underneath an independent table; this table is fitted on the top of the table R. Underneath the independent table is fitted a stud, which works in a curved guide formed in the table R; on the top of the independent table is fitted a guide plate or fence for guiding the wood operated on. This table is used for the purpose of cutting away the wood of the treads and risers of stairs. When the independent table is parallel with the table R, the treads are cut straight on one side by means of a bit; but by means of a handle and screw the independent table is made to work sideways, giving the required angle to cut away the wood of the treads and risers, cutting the wood at an angle giving the required width at the end, for the purpose of wedging the treads and risers up to the proper joint. The mortise bits



are made of steel, and formed with three, four, or more distinct cutters of a spiral curved shape, cut round and lengthways of the boring bit, and sharpened on the edges. When boring for first passing through the article to be mortised—all the cutters are acting, but only one or two cutters are on the cut when the bit or wood is made to travel sideways or horizontally, that is to say "slotting;" the other cutters steady the bit, preventing it working sideways, and producing an evenly cut mortise hole. The mortising machine is shown fitted with moulding bit and apparatus for keeping the wood in position during the operation of cutting the mouldings. On the table R, Figs. 88 and 89, are fitted plates C^2 having jaws D^2, in which work spring levers having friction pulleys F^2 fitted in the ends; these friction pulleys are kept pressed against the wood G^2, which is operated on by the screws H^2, giving the required pressure, and preventing the wood working sideways during the operation of cutting the mouldings. In the spindle E is fitted a moulding bit or tool; this tool is made with five cutters of a curved shape. The bit or tool can be made of any pattern to suit the required mouldings; on the bottom part of the bit is formed a stud K^2, which fits in a hole formed in the top table R, and the top L^2 is made taper to fit the spindle E. Figs. 90 and 91 represent the mortising machine fitted with apparatus for cutting shoulders and tenons. On the table R is bolted a frame S^2 having slides T^2, in which are fitted the bearers of the saw spindles V^2; these slides or bearers are raised or lowered to suit the thickness of the wood to be cut, and are actuated by screws W^2, worked by the handle Y^2, which is made to fit the heads of the screws W^2. On the ends of the spindles V^2 are fitted small circular saws X^2, which are actuated by a rope or belting Y^2 working over pulleys; the circular saws X^2 cut the shoulders of the tenons, and prevent broken shoulders, and consequently bad workmanship. On the end of the spindle E of the mortising machine is cut a screw, on which is a disc A^3 having three cutters or sections of a saw B^3 fitted on it, with spaces for the purpose of clearing the cutters from

the chips or sawdust. A similar disc D^3 is fitted underneath the disc A^1, having similar cutters; the top disc cuts the top, and the bottom one the under side of the tenon. Between the discs is fitted a wooden washer E^3, and this washer varies in thickness according to the thickness of the tenons to be cut. A set screw F^3 is passed through the bottom disc and washer, and screwed in a boss of the top disc. The wood operated on is made to slide on a top sliding frame H^3 working on bottom frame I^3; stops and a brake are employed to keep the wood firmly fixed on the sliding frame H^3, and to regulate the length of the tenons being cut; the sliding frame H^3 brings the wood first through the circular saws cutting the shoulders, and afterwards through the discs cutting the tenons. For planing wood a long wooden or iron table is fitted on the table R, and the spindle of a planing tool is screwed on; the table for planing is actuated by gear fitted on the table R and bracket L.

While the mechanical engineer has been busy on these admirable machines for cutting up, planing, shaping, boring, and otherwise acting on wood, the lathe has also submitted to modifications, and some valuable subsidiary apparatus has been placed in the turner's hands.

How old the practice of turning wood or metal is, we know not; but we know that the potter's wheel is the earliest piece of manufacturing machinery recorded, and the lathe is, in principle, but the potter's wheel placed horizontally instead of perpendicularly. The first attempt at turning was probably by suspending the work between fixed points, and causing it to revolve by means of a cane or other bow, the string of which is wound two or three times round first one portion and then another of the wood to be turned. The bow is still in great use in manufactures, for drilling and for executing delicate little operations, such as those of the watchmaker, who requires to have his work perfectly under his command, so that he may begin to cut exactly at any one point, and leave off exactly at another given point; but turning in the general sense, with a bow, is a slow operation, as one of the workman's hands is required to manage the bow, and its peculiarities mentioned above make it specially unfit for continuous work. The bow, therefore, doubtless soon gave way to the pole, or, first, the bow-lathe worked with a treadle; the bow-lathe we never saw in use, and we believe it is not to be found in any shop in the United Kingdom. Fig. 92 represents this primitive lathe, which was a poor, limited affair, and was set aside by the pole-lathe, in which all the parts are nearly as simple as in the bow-lathe; but by the adoption of a taper piece of lance or other wood possessing great strength and elasticity, six or more feet long, the thicker end of which is fixed firmly to the ceiling, and the other end being directly above the work, work under hand is made to revolve with great speed, which is an immense advantage in the case of turning alder and other soft woods, used for many purposes; the pole-lathe, therefore, and perhaps also on account of its cheapness, is still in use by bobbin, bowl, and other turners of soft wood. The amateur or beginner would, however, find it one of the most unhandy machines he ever touched: the moment the foot is on the treadle the work revolves rapidly; the tool must, for soft wood, be applied instantly and on the top of the work, skimming off the shavings, not scraping them as it were with the tool on the level of the axis of the work, or nearly so, as in turning hard wood, ivory, bone, and other materials; before the treadle reaches its lowest point, and the work begins to revolve in the reverse direction, the tool must be withdrawn. It requires considerable experience before the management of the pole lathe is attained, and, we need scarcely add, its applications are necessarily very limited.

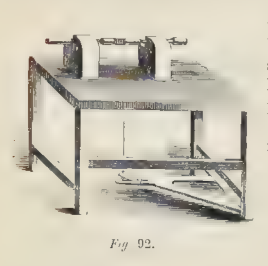


Fig. 92.

Bow- and pole-lathes are sometimes called centre-lathes, because the work to be turned is suspended between two points, one fixed and the other adjustible by means of a screw: the lathe in common use at present is a centre-lathe—long pieces of wood to be turned are suspended precisely in the same manner, only they are made to revolve by means of a chuck attached to the mandril; but this mandril, or spindle, which gives its name to the lathe we are now speaking of, enables the turner to turn face-work, or work at any angle, dispensing entirely with one of the points.

Those who are not acquainted with the principle and details of a lathe will, we trust, obtain a fair notion of both by studying the accompanying engraving of one of approved modern construction, Fig. 93, manufactured by Mr. Edward Hines, of Norwich and London. In the first place, disregarding secondary features, such as the large wheel outside the framing, and all the arrangement at the top of the engraving, the essential parts of a lathe, of every lathe, are first the fly-wheel A, with its axle and crank B set in motion by the treadle C, which, by means of a catgut band, drives the pulley mounted on the spindle or mandril D, which turns in its frame at the extreme end of the bed of the lathe, and the poppet-head E, as it is called, which occupies a similar position near the other end of the bed. The mandril has a protruding screw at the working end, so as to receive *chucks* of various forms; in the engraving, the chuck F screwed on the mandril has a three-pronged piece of steel in it. Now suppose a piece of wood, to be converted into a bed-

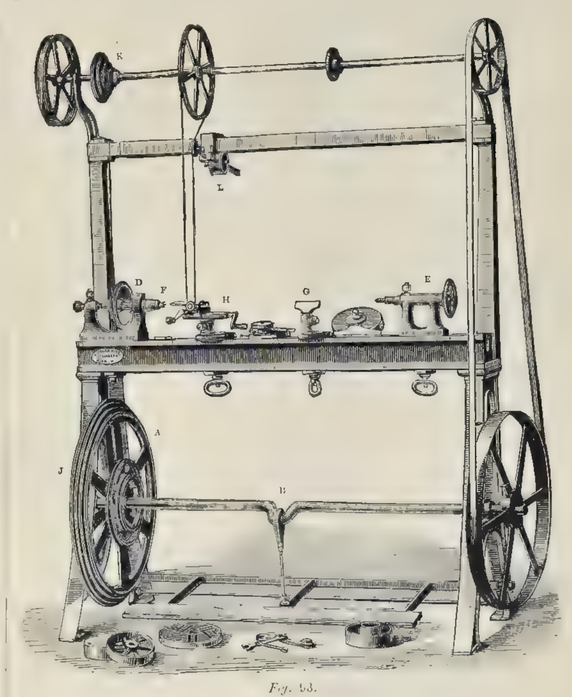


Fig. 93.

post or any other piece of furniture, to have the centre of one end driven upon this three-pronged chuck, and the centre of the other end supported by the point in the poppet-head screwed up sufficiently tight; it is evident that when the mandril revolves the wood will turn with it, and we have a continuous centre-lathe complete: the only other necessary piece for common work being the principal hand-rest G, upon which the turning tools are held by the operator, and the cutting or other tools. So far we have dealt only with the lathe in its simplest form; but for special and ornamental work the additions are numerous.

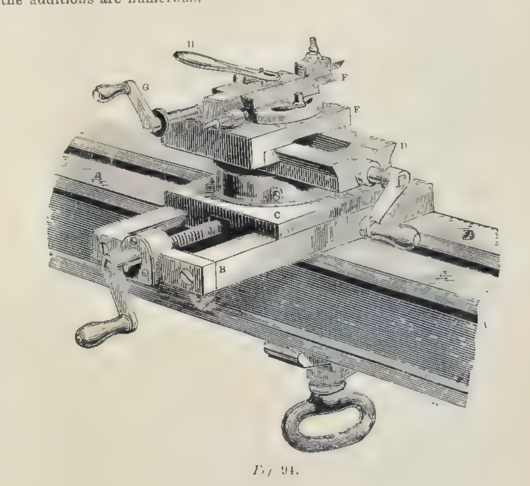


Fig. 94.

In the first place, when geometric or any accurate work has to be done, the ordinary hand-rest for the tools becomes inapplicable, and the slide-rest H comes into operation. Fig. 94 represents an approved form of a slide-rest for all purposes, also by Mr. Hines: A is the bed of the lathe, on which the slide-rest is fixed by means of a strong screw and nut, the bow of which is shown beneath the lathe-bed; B is the bed plate of the slide-rest, fur-

nished with a leading screw, that acts upon a nut in the plate C, which can consequently be moved forward or backward to the extent of the screw; upon C is a socket into which a stud on the upper slide D is fitted, and where it may be set at any angle; D like B is furnished with a screw, which passes through a nut in the piece E; this last-mentioned piece carries the tool-holder F, which also can be moved round to a certain extent by means of the circular plate shown in the engraving, with its curved slots and binding screws. The tools used with the slide-rest are small bars of fine steel with > shaped or other points carefully hardened and tempered: one of these tools is shown fixed in its place by the binding-screw above, and its point protruding at F. The tool-bearing piece has a small slide of its own and a set screw G, which allows the slide to be drawn back freely, but not to advance beyond a certain point, so that the turner, by means of the hand-lever H, allows the tool to cut gradually, according to the nature of the material, until stopped by the set screw G, which tells him that the cut is complete. With such a slide-rest, then, work revolving in the lathe can be cut and worked on the face, at the side, or at any angle between the two, and any number of circles, of any fixed depth and at any required distance from each other, produced with unfailing regularity. The slide-rest holds the tool wherever it is wanted; it remains to explain how the work is held in its place. We have described the ordinary fork chuck F, which, with the aid of the fixed point in the poppet-head E, sustains long pieces; the next thing to be done is to show how work is managed which has to be turned or ornamented on the face, turned hollow, and so on. In a turner's shop these chucks are numerous, but they form after all only three or four groups. The common wood-turner's chuck consists of a circular cup of iron or brass with a screw to fit into the mandril: this cup or metal chuck is filled in with a piece of wood, which in its turn is hollowed out in the lathe to receive any kind of work in hand, such work being tapped in with a mallet, the turner taking care to place his left hand firmly at the back of the pulley, in order to prevent any strain on the screw which presses up the mandril into the collar in which it works; when the work is small and of a light nature, the chuck is chalked inside to give it more hold on the work. In the case of these ordinary chucks the turner has to shape them for himself, to suit any special piece of work he may be called upon to execute: some of these must be inside and some outside; for instance, in turning a common wooden box, the body and the lid must each be chucked twice, once in an inside chuck to hollow out the work, and once in an outside chuck to finish the top and the bottom. These ordinary chucks require no further explanation. When a considerable number of any one article is required to be turned, special chucks are used, which at once save time and ensure uniformity. Fig. 95

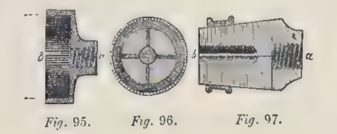


Fig. 95. *Fig.* 96. *Fig.* 97.

represents a brass box chuck, to be filled up with wood as above described, and Figs. 96 and 97 longitudinal and transverse sections of a very convenient form of chuck much used for small work. Both these chucks are made with inside screws, and consequently for lathes with outside screws; but wood-turners more frequently use lathes with inside screws, and of course chucks with the reverse. Another very useful chuck is the face-chuck: a disc of iron turned perfectly true on the mandril of the lathe, in which are a number of slits cut, the work being fixed upon the chuck by means of small bolts and nuts which pass through these slits; such a chuck is represented on the ground in Fig. 93, I. Another kind of face-chuck is used in cases where work has to be centred truly at starting: this is of the same form as the preceding, but it has four slits only, and these radiating from the centre; crossing the chuck and lying within the slits are two double screws, right and left-handed, and each of these carries a small stud or claw, so that when one of these screws is turned, the claws of the two opposite slits advance or withdraw from the centre simultaneously, and this being the case with both sets of claws, the work is nipped in a central position. A very useful chuck is made of iron, with a sharp taper screw about an inch long in the centre, on which to run soft wood work in which a small hole in the centre is not of importance. Chucks are made of many forms, according to the work in hand; but the above descriptions will be sufficient to give any intelligent youth an idea of what turners require; but in addition to chucks to hold work, there are chucks to carry tools, such as the drill-chuck, much used—a metal chuck, with a square hole in which the drill is fitted; the circular-saw chuck with spindle, the end of which is supported by the screw in the back-centre poppet-head E, Fig. 93: over the saw is fixed a small table which can be raised or lowered as desired, allowing the saw to appear through it to the height of one, two, or more inches, as required; on the table is a metal guide, with a quadrant and screw, so that it can be set parallel to or at various angles from the saw. For cutting up hard wood, bone, and ivory for turning, the circular-saw is invaluable, and the cabinet-maker finds it extremely useful in cutting mitres or any other nice work.

In the case of expensive hard woods, and especially ivory, it is important not to waste the material, but to get the largest possible circle out of an irregular piece of material. When the work presents no difficulty, any projecting angle would first be cut away with a chisel or rasp, and nothing more is then required but to drive it into the chuck; but when a long piece has to be dealt with, it is necessary to find the centre with tolerable accuracy; this is easily done with the aid of a pair of compasses. The end of the work is laid on a bench or plank, the compasses opened to nearly or quite half the thickness of the wood, and a curve struck; this being repeated four times, the wood being turned one quarter over each time, lines drawn across through the intersecting of the four arcs will give the centre. This is only necessary in the case of irregular pieces of material; if the wood be previously squared, nothing more is required than to draw two lines across from the opposite angles, and the point where these lines cross will of course be the centre. In all cases, when the centre is found it should be marked with a punch, so that the point of the back-centre screw shall be exactly in the line of the centre of the wood.

Thus far we have only dealt with the means of supporting work in the lathe for ordinary concentric turning; but it is frequently necessary to work out of the centre: for instance, suppose a number of orifices have to be cut in a tray, disc, or any other piece of work, at given distances around the centre, it is obvious that the work must be made to revolve on a false centre, or these orifices cannot be produced. The necessary arrangement is made by means of the excentric chuck shown in Fig. 98, in which *a* is a socket for screwing to the mandril; *b b* the chuck, formed in the same piece with the socket *a*; in front of the chuck is a dove-tailed groove, formed by two pieces *d d* screwed to the chuck; in this groove is fitted a slide *e e*, to which a centre pin is fixed, and a circle *f* fitted to the centre pin so as to turn round freely. A screw *g* projects in front of the circle for fixing chucks thereto. A screw *k* allows the slider to be gradually moved in the groove, but retains it firmly in the position in which it is placed. By means of this screw the centre pin of the circle *f* can be made either to coincide with the line of the mandril, or it can be set with any required degree of excentricity from the mandril, as is shown in Fig. 98, by the difference between the line of the screw *g* and that of the socket *a*. The circle is divided round the edge with equidistant notches or teeth; and a tooth or catch *h* is fitted on the slider by a centre screw, and has a tooth which can be inserted into any of the teeth at pleasure, so as to prevent the circle from turning round upon its own centre pin. The work which is fixed to the screw *g* will evidently turn round with the mandril. Now when this chuck is screwed to the mandril by the internal screw at *a*, the screw *k* is turned until *g* is brought exactly into the line of the mandril.

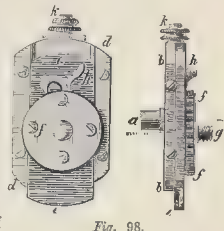


Fig. 98.

Now it is evident that if the slide of the excentric chuck be drawn out one inch and the lathe set in motion, a tool presented to the work will strike a circle one inch out of the centre of the work, the diameter of the circle depending entirely on the position of the tool; then if the circular plate be turned, say half round, another circle will be struck also precisely one inch out of the centre, but on the opposite side; and, by turning the plate *f* a quarter, an eighth, or only a sixteenth of its circumference round each time, four, eight, or sixteen circles will be struck all in a ring one inch from the centre. In short, by drawing out the slide a smaller or greater distance, any circle, or hole, may be cut at that distance from the centre of the work. This is *excentric* but it is still *circular* work, and the lathe produces *oval* work also; this is managed with the intervention of the *oval*, or, more properly, *elliptical chuck* shown in Figs. 99 to 102. The oval chuck (the inven-

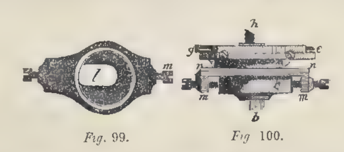


Fig. 99. *Fig* 100.

tion of Abraham Sharp) consists of three parts, the *chuck*, the *slider*, and the *excentric circle*. The chuck is secured to the mandril by a screwed socket cut in a piece *f*, Fig. 102, which projects from the centre of it behind, so that the chuck partakes of the circular motion of the mandril. In front of the chuck is a dove-tailed groove formed by the pieces *i i*, Fig. 101, for the reception of a slider *g h*, from the centre of which projects a screw *h* for the reception of a wooden chuck which holds the work. By this arrangement the work in turning round by the motion of the chuck has a sliding motion across the

centre, by which means an ellipse is generated. This sliding motion is given by means of the excentric circle, Fig. 99, or ring of brass fastened to the poppet of the lathe close to the collar in which the neck of the mandril runs. The mandril passes through the aperture *l*; the flat plate *m*, which strengthens the ring, has at each end a bend *m*, with a screw in each exactly opposite each other: the screws have sharp points for insertion in small holes in each side of the poppet, as at C, Fig. 100, the back of the

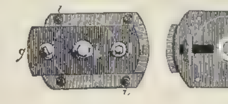


Fig. 101. *Fig.* 102.

plate *m* of the circle lying flat against the flat of the poppet C; by which means the circle is fixed. The two screws are horizontal, and both point to the centre of the mandril *b*, so that by screwing one screw in and the other out, the whole circle may be moved sideways horizontally, so as to give the required degree of excentricity from the centre line of the mandril, and it will be held stationary wherever it is placed. The back of the chuck, Fig. 102, shows two grooves made through it in the direction of the length of the slider, for admitting the shanks of two pieces of steel, *n n*, to pass through the chuck; they are attached to the slider *g* by screws in front, as shown in Fig. 101. The two inside edges of *n n* are parallel to each other, and the distance between them is equal to the diameter of the outside ring, Fig. 99, the ring being included between them when the chuck is screwed to the mandril *b*, and the circle fixed to the poppet C as in Fig. 100. Now if the circle be set concentric with the mandril, the chuck, the slider *g*, and the work attached by the screw *h* will all be concentric, and circular work will be turned, the slider being guided by its claws *n n*, which embrace the circle. In order to set the work for an ellipse the point of a tool in the slide-rest is placed opposite the work, so far from its centre that it will describe a circle of a diameter equal to the breadth or smallest diameter of the intended ellipse. The mandril is now turned until the slider *g* is horizontal; the circle is then set excentric from the mandril by means of its screws *m m*, by which means the slider *g* will be moved in the groove of the chuck, but the work will be moved with it to a greater distance from the centre, because the two steel pieces *n n* include the whole circle between them. "The quantity of excentricity given to the ring must be equal to the difference between the two diameters of the required ellipsis, so that the work shall move or throw out a sufficient distance to bring the point of the tool as much beyond the circle first described, as the length of the ellipse exceeds the breadth. The point of the tool will now be at one end of the longest diameter, and here we will commence to trace the curve all round. In turning the mandril round till the slider becomes vertical it must return in its groove to the place it first occupied, viz. the centre; because the excentric circle which guides the slider is not excentric in a vertical direction, though it is in a horizontal. In this motion the point of the tool has cut or described one quadrant of an ellipse, because it gradually approached the centre of a quantity equal to the excentricity of the circle. By continuing to turn the mandril round farther, the circle will cause the slider to move out the other way from the centre in its groove until it comes again horizontal, when it will be at the greatest *throw out*, as the turners term excentricity, and the point of the tool will be at the other end of the longest diameter, having described one half the curve: continuing to move forward till the slider becomes vertical, it will become concentric again, and the tool will be at the breadth of the ellipse, having finished three-quarters of the ellipse; and in turning the next or fourth quarter, the slider throws out till it comes horizontal, and brings the work to the position where we first set out, viz. at its greatest excentricity; and with the tool at the end of the longest diameter of the ellipse." * This chuck is sometimes provided with a click, or even with a micrometer plate, for placing the ovals in different directions.

By using the excentric and the oval chucks in combination, ovals may be struck, cut through, or sunk in the work with any amount of excentricity; but this is an unusual combination in ordinary work.

* "Rees's Cyclopædia." There are several excellent articles on Turning in this work, to which we have been considerably indebted in the preparation of this article. But as these articles are not accessible to the general reader we would recommend a work among the Manuels-Roret, entitled "Nouveau Manuel complet du Tourneur," by E. de Valicourt, in 3 vols (Paris, 1848–1853.) This work is chiefly compiled from the celebrated treatises of Plumier, Bergeron, Desormeux, Dessables, Mapod, and others, which have long been out of print. With the exception of the "Handbook of Turning," there are very few works in English on this important art. In 1817, "Specimens of Excentric Circular Turning" was published by John Holt Ibbetson, Esq.; and in 1825, a second edition of the same work; and in 1838, a third edition, greatly enlarged. In 1833, Mr. Holtzapffel published an account of Ibbetson's geometric chuck, with specimens. In 1819, Mr. C. H. Rich, of Southampton, published "Specimens of the Art of Ornamental Turning," and also "Tables by which are exhibited at one view all the divisions of each circle of the dividing plate." The *Mechanics' Magazine* also contains a number of valuable articles on turning.

The tools used in simple turning are but few, and present no very remarkable features. The roughing tools are gouges, which are ground up to the form of the narrow end of an egg; then come chisels, which are sharpened on both sides, and at an angle, not square across like a carpenter's. With these two the soft wood turner can turn almost anything, but his tools must be sharpened at a very acute angle. For hard woods, ivory, and bone, the tools are quite different, and very few and simple: the rasp does the rough work before the material is placed in the lathe, and the shaping is principally effected by means of small chisels, Λ-shaped tools, and a very narrow tool called a parting tool, for separating a number of small articles shaped out of the same piece of wood. These tools can all be obtained at the shops, but the true turner generally makes his own, out of worn-out files, to suit his special requirements; he has only to temper them, grind one face, and sharpen them—operations with which every workman should be familiar. Files are harder than cutting tools should be, therefore they should be heated to straw colour and plunged in water or oil, ground to about an angle of 45°, and worked to a fine edge on the oilstone. Other tools are used to sink and to raise mouldings, circular, sharp-angled, &c., but they are not often required.

When the slide-rest is used in place of the hand-rest, as it must be in all complicated work, the tools are the same in form as those just mentioned, but made of squared steel, as already stated, and without handles.

Beginners, amateurs in particular, find much difficulty in grinding and sharpening their tools: we are inclined to recommend them to try the emery wheels specially arranged for those purposes.

There is, however, another class of tools, not cutting tools, which produce ornamental edges and bands, called milling; these consist of small roulettes, little discs of steel about half an inch in diameter, on the edge of which the pattern is sharply cut in reverse, and these roulettes are mounted by means of a pin, on which they revolve, in a notch at one end of a piece of iron, which is either held in the hand on the ordinary rest, or fixed in the slide-rest, like any other tool, and the effect is produced simply by pressure.

The overhead motion now added to all lathes of the best kind deserves special notice, as it enables the turner to perform some operations with much greater ease than without its intervention. The arrangement referred to is that by which the slide-rest itself, or working apparatus fixed in it, is driven automatically by the crank and treadle, as the mandril is. A good form of the overhead motion is shown in the engraving of the lathe already referred to. Outside the frame of the lathe, Fig. 98, is a driving-wheel with a band, which gives motion to the small shaft and its pulleys K above. Another band connects one of these pulleys with the slide-rest or apparatus fixed in it—this arrangement gives a very rapid motion; a small drilling-frame which fits in the rest, and has a minute pulley at one end, is a very effective instrument. In drilling, for instance, instead of having to hold the work up to a drill in a chuck in the mandril, the work is on the latter; and, by means of a brass plate on the face of the pulley, divided and drilled with several circles of small holes, and a point mounted in a small piece of elastic steel fitted to the mandril stock, the work may be held in any desired position, and holes drilled in circles, in spirals, or, in short, in any position required: nor is this confined to drilling holes; many ornamental tools are used instead of drills with this little apparatus, which will produce rosettes or other small decorations with great rapidity.

The ornamental hard wood and ivory turner makes great use of this little frame, and when the excentric chuck is employed in connection with it, most complicated patterns are produced. A still further step is made when the mandril, and consequently the work under hand is made to move slowly while the drill-tool is in action, the small pulley at K being provided for this purpose. Epicycloidal curves are produced on the face of the work thus: suppose the drill-tool to be set to cut circles an inch in diameter, and the mandril to move round at the rate of half an inch during one revolution of the drill-tool, the circles will be converted into a curl with half-inch loops, and when the mandril has completed a revolution the curl, which is a true epicycloidal curve, will be complete. Now suppose the excentric chuck placed on the screw of the mandril with the work on the chuck, and the slide at the chuck drawn out to a given extent, as described above, any number of these beautiful epicycloidal curves may be executed on the face of the work, either following or overlapping each other.

It would be beyond the scope of this work to enter into the details of ornamental turning, but what we have just said will show the great capabilities of a lathe with these combinations. But there are applications of this overhead apparatus which specially belong to cabinet-making: as already stated, raised circular ornaments may be formed out of a fillet left around the leg of a table for the purpose, the waste wood between the rosettes being afterwards cleared off by hand tools; or, on the contrary, they may be sunk in the wood, as in the case of ebony work, where the surface is highly polished, and the ornamental work sunk and left unpolished, producing a most charming effect. Again, the leg of a table, &c., in the lathe may be fluted by keeping the mandril fixed, and moving a revolving semi-circular

cutter in the drill frame gradually along the distance required to be fluted; and if a very slow motion be given to the mandril, these flutes may be twisted around the work. If a pulley from above be placed on the screw of the slide-rest, so that a shaped cutting-tool shall advance one-eighth of an inch during one revolution of the mandril, a screw of that pitch is easily cut, and with a long slide-rest and similar arrangements, spiral or twisted work of any kind may be produced. The small runner, mounted on a horizontal shifting bar L, Fig. 93, is an arrangement for loosening or tightening the driving cat-gut band, to suit the required position of the slide-rest.

Many interesting adaptations of the lathe are used to produce ornamental or irregular work from a model, and they are most useful machines; some are similar in principle to the rose engine, which has a rocking as well as rotatory motion. They are known as copying lathes, rocking lathes, joggling lathes, &c. Fig. 103 represents a "double spoke or copying lathe," made by Messrs. Ransome and Co. It is designed for shaping spokes, gunstocks, adze, pick, or hammer handles, and other similar articles to a pattern, and it will shape twenty to thirty spokes of ordinary length in an hour, two being cut at the same time. The cutters work against the grain, and do not split or splinter dry wood. The pattern, which is made of iron, and the two pieces to be shaped, are held side by side between centres, and all three are made to rotate by a self-acting motion, worked by gear-wheels so arranged that both the pattern and the two pieces to be shaped move at precisely the same speed and in the same direction. As the iron pattern revolves it acts upon a small friction pulley attached to the slide-rest which carries the cutter heads, thus causing them to advance and retire in conformity with the shape of the pattern, and the result is that the wood is cut to the precise form of the template. It will be seen that this is an inversion of the rocking lathe, namely, a moving slide-rest. The side which carries the cutters is made to travel along the bed by a screw motion, giving it a speed of from one to two feet a minute, and as it acts in either direction, no time is lost while the cutter carriage is returning. By a simple arrangement, the machine, after shaping each pair of spokes, throws the traversing motion out of gear, thus causing it to stop without any attention on the part of the operator. The cutters are driven from an overhead shaft, with a long drum to allow of the belts travelling to the full length of 3 feet 6 inches, which is the working capacity of the machine.

The high speed at which the cutters are driven enables them to turn out very clean work, and the labour of finishing, after leaving the machine, is thereby much reduced; but the circular form of the cutters leaves a series of small ridges on the work, which are removed by means of sandpaper applied by hand, or by a "buffing" machine.

Wood-work when finished, as regards form, requires a good deal of labour and care to perfect it; in the case of turned articles, the finishing is very easy, the application of a piece of sandpaper to the work as it revolves in the lathe speedily takes out the tool-marks, and produces an even surface, which is further improved by finishing with worn-out scraps of the same paper, or the shavings and dust of the wood itself; this is generally sufficient for ordinary articles in hard wood, but turnery in soft wood is finished with varnish. Turned portions of furniture must, of course, be finished in the same manner as the other parts, or there would be a want of harmony in the general appearance.

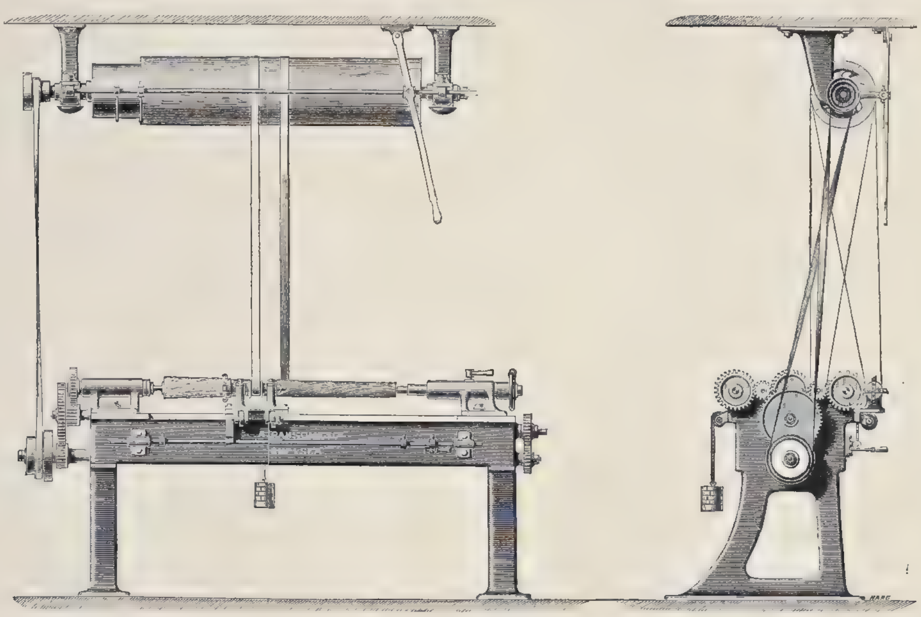


Fig. 103.

When a piece of work is put together, often before it is all put together, the surface of the wood must be rendered perfectly even, by scraping and sandpaper; and this requires especial care in the case of light-coloured wood, particularly if the grain be soft. When the surface is worked perfectly, a coat of varnish is laid on, and in the case of white or light-coloured wood, great care must be taken that the varnish is colourless, and the only way to be assured of this is to try it first on a piece of spare wood of the same kind. The general idea of varnish is doubtless that when once laid evenly on the wood there is nothing more to be done, as is the case of painted wood and other matters; but to obtain the brilliancy of high furniture varnish, the varnish itself has to be polished until its surface is as free of brush marks and almost as brilliant as a mirror. This polishing of varnish requires considerable care and labour; it is performed with the aid of rotten stone, whiting, putty or tripoli powder, according to the fancy of the workman; the powder is partly covered with water, and the polishing is effected by means of a piece of cork with several folds of fine flannel. In the case of porous wood, before the varnish is laid on, the surface is dressed with clear size, which, when dry, is rubbed down gently with very fine glasspaper: the object of this is to save the sinking in of the varnish, and its consequent waste. Polish is put on by means of a rubber made of coarse woollen or flannel, rolled tightly, with the polishing end covered with several layers of fine linen, old being better than new—nothing better than a worn-out cambric handkerchief: a very small quantity of the varnish is put on the rubber at a time by giving the bottle a jerk with the rubber over its mouth, and rub it until the linen seems dry. Most polishers, we believe, rub in circles, but that probably is an error; the requisite is that two or three coats shall be put on as evenly as possible, and to do this well requires great care that the varnish is good, the rubber perfectly clean, and no specks of any sort be allowed to fall upon or remain on the varnished surface.

What is called oil-finish is thus described, evidently by a practical hand, in the "American Cabinet-Maker," who explains the process of finishing a piece of first-class furniture, starting with the wood in the white, and going through the different operations in their regular order, so as to introduce the methods of black-lining or ebonising, polishing, and gilding.

"Remember, the wood is in the white, and the first thing to be done is to give the veneered panels a coat of shellac. The object of this is to keep the oil from discolouring the veneers, and to keep them as light in colour as possible, for the lighter they are the better the natural shades of the wood will look when finished.

"Next, the parts that are to resemble ebony should be blackened. In

order to do this, first dissolve ½ lb. of extract of logwood in one pint of water, either hot or cold, and wi h the stain thus formed give the parts to be blackened two coats, applying the same with a brush of suitable size; secondly, put 1 lb. of old iron, in small pieces, into a glass bottle or an earthen jar, with a pint of vinegar; let this stand 24 hours, and then go over the parts you have previously stained with logwood with the iron and vinegar, and you will have as good a black as can be made, and one which the longer it stands the blacker it becomes.

"Next in order is the filling process. The filling is made as follows: Mix together, in any suitable vessel, ½ pint boiled linseed oil, 1 ditto japan, ½ ditto spirits of turpentine, 1 lb. corn starch, ½ ditto burnt umber, and 2 oz. rose pink.

"The umber and rose pink are added for colouring, and the workman must use his own judgment as to the quantity, using more or less according to the shade he wishes to give his work. The filling, which upon mixing is ready for use, is to be applied with a brush. No particular pains need be taken in putting it on, only to see that all parts of the work are thoroughly covered with a heavy coat. After the filling has been on about half an hour, wipe it off *clean* with rags. Brush the carvings out with a stiff brush made of hair-cloth, and clean the corners and crevices with a pick made of hard wood, sharpened to a point. Let the work stand overnight, and on the next day give it a coat of shellac on all parts. The veneer should now be scraped with a cabinet-maker's smooth-edge scraper.

"The first coat of shellac was put on to prevent the filling from having any effect, but the scraping accomplishes that purpose, leaving the pores of the wood perfectly filled, and it serves also to bring out the light and dark shades of the wood. When the veneers are properly scraped and sandpapered, give them alone a coat of polishing varnish; let the work stand until the next day, and then sandpaper the parts that have had the shellac applied to them, and give them a coat of rubbing varnish, and the veneers a second coat of polishing varnish; the next day repeat the process.

"The veneers having now had three coats of polishing varnish and one coat of shellac, the work, after standing one or two days to harden, is ready to finish. In this process, the veneers are to be rubbed with fine-ground pumice-stone and *water* applied with a soft rag, and the other parts of the work with ground pumice-stone and *oil* applied with a piece of hair-cloth. The work should be cleaned off with rags, and, in order to insure the beauty of the work, much will depend upon its being perfectly freed from oil and pumice-stone. To polish the veneers, which is the next step, use a clean woollen rag, clean *water*, and a piece of lump rotten-stone—wet the rag and the rotten-stone in the water; rub the stone on the rag until it is filled with it, and then apply it to the veneers until all scratches and marks of the pumice-stone are removed. The rotten-stone should be rubbed off with the bare hand as clean as possible. Wash off the remainder with a sponge, and dry with a chamois skin; then 'bring up' the polish with the palm of your hand, by pressing it over the work lightly, until the desired effect is produced. While doing this, be particular to keep your hand and the work free from oil and dirt. After giving the parts that have been blackened a coat of clean-flowing varnish, the work is ready for gilding.

"The engraved lines to be gilded must first be carefully cleared of all oil and pumice-stone, and made smooth with a piece of hard wood sharpened for the purpose; give the parts to be gilded a thin coat of shellac as a foundation for the sizing. Slow size is the best, and is made by mixing a little chrome yellow in oil—the older the oil the better; apply this with a suitable size brush, and be careful not to touch any part except where you wish to gild; let the work be placed in a horizontal position, as the sizing is apt to run. Having stood overnight, covered with paper to prevent dust from settling in the size, the next day the work will be ready for the gold. The application of this part is done by first blowing a leaf of gold out of the book upon a gilder's cushion; spread it out with a gilder's knife, and make it smooth by gently breathing on the centre of the leaf; cut it into strips suitable for the work, and with a gilder's tip, having rubbed it on your hair, take up a strip and lay it on your work. When all the space required is covered, clean off the superfluous gold with a round camel-hair brush, remove the gold outside of the lines and edges with a piece of chamois skin, and the job is complete.

"In finishing walnut work, the most important consideration is to have the open grain of the wood perfectly filled, so that when the work is finished, it will have a smooth, glass-like surface. To best accomplish this, use some one of the so-called patent fillers. Oil-finishing, like French-polishing, is not fully understood, and is very poorly performed by many workmen. When properly done, however, it is the best and most perfect finish that can be given to hard woods, such as oak, ash, chestnut, and mahogany, as well as to walnut, for it can be varied to suit all conditions. It is the cheapest and best for common chamber or parlour suites, and at the same time can be made the most beautiful for the highest-priced furniture. With it the surface of the wood can be made perfectly smooth, without gloss or polish, and without such body as to be easily marked by scratches, or again the work may have as much body and as high a polish as may be desirable. The use of the filling is of the highest importance, for it can be used to advantage on all grades of furniture, saving as it does both in labour and material, and being very beneficial to the wood.

"A good finish for common walnut bedsteads, cribs, extension tables, &c., can be obtained as follows; First, apply the filler, as previously described, directly to the wood, no previous oiling being necessary; clean off as before, and let the work stand overnight; the next day give a coat of shellac, and, if the work is to be hurried, about two hours after the shellac is put on, take a piece of coarse burlap—the coarser the better; wet it with raw oil only, and rub over the work until the coarse feeling of the shellac is removed; clean off with soft rags, and the finish is complete. If the filling has been properly mixed and applied, and the shellac has been laid on smoothly and evenly, this will be found a very good finish, suitable for all kinds of low-priced walnut work.

"For higher-priced work the process is as follows: Put on the filling as before, and on the next day give it a coat of shellac; and after a few hours sandpaper the work with No. 1 sandpaper, and then give it two coats of No. 1 furniture varnish, allowing it to stand 24 hours between each. Forty-eight hours afterwards rub it down with ground pumice-stone and water, using a piece of burlap; wash off with a sponge, dry with a chamois skin; take a woollen rag, wet with raw oil and dipped in pulverized rotten-stone, and rub the work over with that. It may now be cleaned with soft rags, and a fine gloss will then be found upon the work. For the mouldings or carvings have ready, in a bottle, ½ lb. of gum shellac dissolved in one pint of alcohol; take a small piece of cotton wadding, wet it with the mixture, and place over it a piece of thin white muslin, so as to form a ball or pad; pass the pad lightly over these portions of the work, and it will produce a good polish. If you have veneered panels on your work, give them a clean, smooth coat of flowing varnish; or you can polish them as previously described, or you can finish with French polish.

"For an oil finish for walnut work in the natural colour of the wood, or light finish, the following method will be found to result favourably. First give the veneers a coat of white shellac; blacken the parts to be finished in imitation of ebony, the process for which has already been given; have ready a filling made as follows: Mix together 1 pint of spirits of turpentine, 1 lb. of corn starch, ½ lb. of whiting, and ½ pint of japan. Use no oil; apply the filler and clean off as before; give the work three coats of white shellac, one coat each day, and sandpaper each coat; let the work stand at least 24 hours; rub down with ground pumice-stone and raw oil, using a piece of hair-cloth; clean off with soft rags; go over your work with the cotton pad, wet with the polish from the bottle; flow the parts that have been blackened and polish the veneers.

"In finishing ash, chestnut, and oak in oil, the beauty of the work depends mainly on keeping the work as near the natural colour as possible. No oil must be used on the wood or in the filling. The filling is made by mixing together 1 pint of spirits of turpentine, 1 pint of japan, 1 lb. of corn starch, ½ lb. of whiting, and ½ lb. of yellow ochre; apply with a brush and clean off with rags. In cleaning off the workman must be very particular, as the least particle of the filling left on the work will show when finished. The next step, after letting the work stand overnight, is to put on the varnish. Varnish is better than shellac, as the latter is too dark to be used. Give the work three coats of rubbing or No. 1 furniture varnish, allowing 24 hours between each coat, and 2 days after the last coat for the varnish to harden. Then rub down with ground pumice-stone and oil, applied with a piece of burlap, and clean off with rags. If you wish more gloss upon the work, go over it again with pulverized rotten-stone and oil, applied with a muslin rag, and clean off as before."

The matching of wood in large pieces of furniture is an important point: not the matching of grain, which is admirably effected, in the case of broad veneered surfaces, by using the veneers cut from the same log, and reversed so that the curls and veins are alternated, but the matching of other pieces as regards colour, or rather tint: sometimes a piece has to be rendered darker, sometimes lighter—for the former effect, sulphate of iron, lime, logwood, aquafortis, &c., are used, according to the prevailing colour of the wood; for rendering the tint lighter, a strong solution of oxalic acid in hot water, with the addition of a few drops of spirits of nitre, is one of the means employed. Lastly, for freshening up faded wood, various substances are used according to the colour, such as gamboge, barberry root boiled in water, or turmeric in spirit for yellow woods: mahogany and rosewood may be treated first with hartshorn, and then with oil in which a little bag of alkanet root has lain for a day or so. Ebony is improved by the use of a decoction of gall nuts, in which steel filings have been steeped; in any case a little of the above substances may be rubbed in with turpentine and oil.

No. 2.—FRETWORK AND INLAID WORK.



FRETWORK consists in cutting patterns in wood for decorative purposes. All the northern nations who construct wooden houses, Russia, Sweden, Norway, and our own colonies, naturally use fretwork for ornamental purposes, and of late years it has been frequently adopted in the same manner to finish off the roofs of our railway stations and other like constructions: the only essential difference between fretwork and inlaid work is this, that whereas the former has a pattern merely cut in it, the latter has that pattern filled up with some other kind of wood, or other material—for inlaying applies not only to wood, but also to ivory, bone, mother-of-pearl, tortoiseshell, brass, and other metals. Parquetry sometimes, marquetry, Buhl-work, Reisner-work, tarsia,* are all inlaid work. Ordinary parquetry, from the French word *parquet*, floor, consists merely of oak, or other wood, about an inch or an inch and a half thick, not inlaid, but cut into certain geometric forms and put together, producing very simple patterns, squares, or, most common of all, that shown in Fig. 1. When curved ornamentation is introduced, as is the case in the palaces

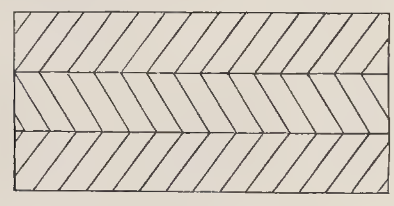


Fig. 1.

and grand mansions in France, then parquetry becomes inlaid work. Most inlaid parquetry, we believe, is cut out in thin wood, which, with its inlays, is glued down on the floorboards; but the improvements which have been made in wood-working machinery of late years have given rise to the production of solid inlaid parquetry—which, although expensive at first, is very durable and highly artistic in effect. Another kind of parquetry has been introduced in this country of late years; in this case the patterns are cut in thin wood, which is glued down upon strong canvas. Marquetry is the general word, adopted from the French, for inlaid woodwork, but it includes all the other materials mentioned above; the old marquetry, which is to be found in almost every collection, and in the store-rooms of all dealers in curiosities, or *bric-a-brac*, was usually decorated with flowers and foliage, and generally exhibited but little art, though great skill. Much of it is said to have been punched out, not cut with the saw. But in the time of Louis XIV. an Italian settled in France, and introduced a new kind of inlaying, which became the rage, and the introducer or inventor was appointed cabinet-maker to the King. There is some doubt about the proper name of this famous *ébéniste*, whose work is called *Buhl*-work in England, and *Boule*-work in France. He introduced an elegant, artistic style of ornamentation, consisting principally of scroll-work, and ordinarily executed in dark tortoise-shell and brass, but not unfrequently in shell and copper, and at times in the precious metals. The decorated cabinets, tables, writing-desks, and other articles produced by this artist exhibit great taste and skill, and were admirably executed, and examples of his work are still highly prized. In the best examples of Buhl-work, the metal inlays were sometimes engraved with much taste. Another *ébéniste*, a German named Reisner, settled in Paris a few years later, and introduced a kind of inlaid work, which was even more delicate in effect than Buhl-work. Reisner worked principally in what our neighbours call *bois de rose*, from its colour, our tulip wood, inlaying with woods of darker colours. His ornamentation was beautifully designed, and he had a fine eye for contrasts, taking advantage for his purposes not only of the colour, but of the grain of the various woods employed. A fine example of his work is of great price now. In Buhl-work the ornamentation generally consists of continuous running patterns, while in Reisner-work it is principally composed of flowers, like the old marquetry, but infinitely more delicate.

* Tarsia, or tarsiatura, mosaic-wood introduced in Italy in or about the fifteenth century, was much used in decorating ecclesiastical woodwork and furniture, especially in Venice.

Having defined what inlaid work includes, our next task is to explain the manner of its execution:—Two pieces of veneer, of equal size, such as ebony and holly, are scraped evenly on both sides and glued together, with a piece of paper between. A piece of paper is also glued outside one of the veneers, and on this the design is sketched: a small hole is then made for the introduction of the saw, in a place where the hole will not be noticed in the pattern.

The saws used in piercing and inlaying differ but in size. The thin black line, Fig. 3, is the piercing-saw, attached to its handle and frame *m*, and the dotted line *w* is the wooden frame of an ordinary Buhl-saw: the former measures 8 inches from the blade to the frame; the latter 12 or 20 inches, to avoid the angles of large works. The wooden frames are made of three pieces of wood, halved and glued together, to form the three sides of a rectangle; after which two pieces are glued upon each side, at an angle of 45°, across the corners: the whole, when thoroughly dry, is cut round to the form represented in Fig. 3.

The Buhl-cutter sits astride a horse, or long narrow stool, Fig. 2, at one extremity of which are two vertical jaws, lined with brass at the top: one jaw is fixed, the other is notched below, and springs open when left to itself, but is closed by a strut, which is loosely attached to the stool by a tenon and mortise, and rests in a groove in the movable jaw. When the strut is pulled downwards by a string leading to the treadle, it closes the flexible jaw of the vice. The jaws are inclined some 20°, so as to be at right-angles to the path of the workman's right hand.

Matters being thus arranged, the Buhl-cutter inserts the saw blade into

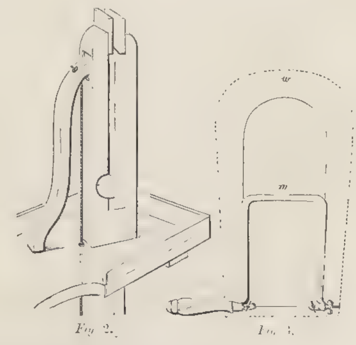


Fig. 2. *Fig. 3.*

the hole in the veneers, and then fixes it in its frame. The work, held in the left hand, is placed in the vice, which is under the control of the foot, and the saw is grasped in the right hand, with the forefinger extended to support and guide the frame. "The several lines of the work are now followed by short quick strokes of the saw, the blade of which is always horizontal; but the frame and work are rapidly twisted about at all angles, to place the saw in the direction of the several lines. Considerable art is required in designing and sawing these ornaments, so that the saw may continue to ramble uninterruptedly through the pattern, while the position of the work is as constantly shifted about in the vice, with that which appears to be a strange and perplexing restlessness. When the sawing is completed, the several parts are laid flat on a table, and any removed pieces are replaced. The entire work is then pressed down with the hand; the holly is stripped off in one layer with a painter's palette knife, which splits the paper, and the layer of holly is laid on the table with the paper downwards, or without being inverted. The honeysuckle is now pushed out of the ebony with the end of the scriber, and any minute pieces are picked out with the moistened finger: these are all laid aside. The cavity thus produced in the ebony is now entirely filled up with the honeysuckle of holly, and a piece of paper smeared with thick glue is rubbed on the two to retain them in contact. They are immediately turned over, and the toothings or fine dust of the ebony are rubbed in, to fill up the interstices: a little thick glue is then applied, and rubbed in first with the finger, and then with the pane of the hammer, after which the work is laid aside to dry."* When dry it is

* Holtzapffel, "Turning and Mechanical Manipulation," vol. ii.

scraped at the bottom, and is then ready to be glued to the box or furniture to which it is to be applied: when the work is again dry it is scraped and polished. The same course is pursued in combining the holly ground and the ebony honeysuckle, and these form the *counter* or *counterpart Buhl*, in which the pattern is the same, but the colours are reversed.

Three thicknesses of wood, such as rosewood, mahogany, and satin-wood, may be glued together and cut as before. The three pieces, when split asunder and recombined, would produce three varieties of Buhl-work, the grounds of which would be of rosewood, mahogany, and satin-wood, with the honeysuckle and centre of the two other colours respectively. Such are called "works in three woods," and form the general limit of the thicknesses.

Brass borders, called *Vandykes*, are worked in narrow slips. The true Buhl, or the wood ground with brass scrolls, is laid down in four or more pieces around one box or panel, and the counterpart, or the brass ground with wood scrolls, upon another.

When the material is small and costly, as pearl-shell, several pieces must be used: these are placed correctly edge to edge, so as to cover the entire surface to be ornamented. The paper-knife, a portion of which is shown in Fig. 4, required eight pieces of pearl-shell. The counter, when glued on another veneer, is not inlaid of the irregular angular form of the



Fig. 4.

Fig. 5.

rough pieces of pearl, but is cut round the general margin of the pattern, as in that portion of Fig. 5 which represents the counter to Fig. 4.

A more elaborate effect is produced by making the saw follow all the device of the counter, so as to leave a narrow line of pearl both within and without: this is called internal cutting, and is shown to the right of Fig. 5.

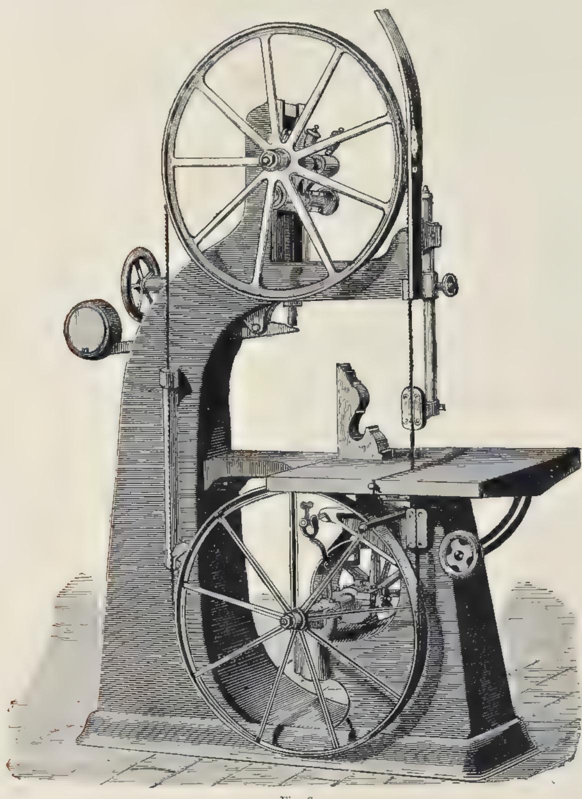


Fig 6.

In the more minute Buhl-works, the parts are not cut exactly square, but slightly bevelled, so that the pearl may be left a little larger than the interstices of the wood, to compensate for the saw kerf and to make the fitting close, as regards the true Buhl. The *stringings*, or the straight and circular lines combined with pearl Buhl-work, are mostly of white metal, such as tin or pewter. Buhl-works of brass and wood are also sometimes made by stamping instead of sawing.

M. Fourdinois of Paris, one of the most eminent *ébénistes* in Europe, whose carved work is of the most delicate and finished description, sometimes takes advantage of the fret-saw to give an additional variety to his decorative work. Taking two kinds of wood which contrast well, he saws them out to pattern as if for ordinary inlaying; but the carver then takes them in hand, and, by working the two woods alternately or otherwise to different degrees of relief, obtains variety of colour as well as of form.* In this case, as in all inlaid work, the two veneers when cut supply two means of inlay; thus a piece of holly and a piece of ebony, for instance, when cut out, will make a white ground with black flowers, and a black ground with white flowers, or other ornamentation.

For fine pierced work, or fret-work, for they are identical, the small saw is still the only tool applicable. To give an idea of the smallest kind of pierced work we must refer to the watch trade; the figures which mark the hours on a gold or silver dial are cut out of sheet gold by the piercing-saw, the blade of which is formed of a fine piece of watch-spring. In the first place the figures are engraved in outline, and then each interval between the parts of the figures sawn through; but in order to do this a hole has to be drilled at one end of the interval, the end of the saw released from the screw which holds it in the frame, inserted in the drilled hole, and again secured to the frame. For the figure XII this operation of drilling and entering and withdrawing the saw has to be repeated at least eight times. Very beautiful pierced and engraved gold work is sometimes introduced in fine watch and goldsmiths' work, which is executed in the same way, the saw-marks being afterwards obliterated by the engraver.

With respect to all other but such minute work as that above cited, the fret-saw has been superseded by machine saws of several kinds. The most

* In the South Kensington Museum is a magnificent cabinet, purchased of M. Fourdinois at the Paris Exhibition of 1867, in which this combination of inlaid and carved work is exhibited to great advantage.

simple of these is a small saw worked by means of a treadle, having a reciprocating, up-and-down motion especially adapted for small fret-work, and to be seen in almost any town in the kingdom; the most important is the band or ribbon saw, which first appeared at the Paris Exhibition of 1855. It was not new, but scarcely known: it had been described by an Englishman, Mr. Newbury, in 1808, and had been used by a Frenchman, M. Touroude, seven years later; but there were defects in it, especially with regard to the brazing of the joint, which no one seems to have succeeded in remedying before M. Perin, a cabinet-maker of Paris, who exhibited it as stated, when it created much interest. He also arranged the table so that the saw would cut at any angle within given limits, and subsequent improvements have made it a most valuable aid to workers in wood and even metal, and especially for decorative work. The band-saw works excessively rapidly, and at the same time very truly when fairly managed. We append examples of most approved forms.

Fig. 6 represents a band saw exhibited at Philadelphia by Messrs. Bentel, Margedant & Co., of which the correspondent of the *Engineer* says :—

"An important improvement in band-saw machines consists in the construction of the upper band-saw wheel, which in appearance does not differ from the ordinary wheel, but a recess of the proper width and depth is formed in the rim; the bottom of the same has a number of projections which are turned true and ground to a circle, corresponding to the diameter of the wheel. The space between the projections is laid with anti-friction material to the exact height of the projection; thus prepared, the recess forms an accurate bed for the reception of a cast steel band or rim, accurately ground on the in- and outside. The steel band is covered with leather to preserve the set of the saw. Oil-holes are provided on opposite sides of the wheel, through which a few drops of best lard or sperm oil once a week will insure sensitive working of the steel band. When the lower wheel and sawband are set in motion, the latter communicates the motion to the upper wheel; but this being at rest, does not follow at once with the speed acquired by the lower wheel, because the steel rim or band slides in the recess on the rim of the wheel and sets the latter gradually to the same number of revolutions as the lower wheel when it attains sufficient momentum. Whenever the velocity of the driving wheel is suddenly reduced, either by the application of the brake or the saw entering the wood, the steel band revolves with the speed of the driving-band wheel, while the upper wheel revolves by the force of its momentum, creating a harmless friction inside the steel band, but not on the saw blade, as is usually the case; thus the slipping of the saw on the upper wheel, which creates heat and crystallizes the saw, is avoided, and the strain on the blade is considerably reduced; in fact, the saw has little or no driving to do, which is of great importance when very delicate blades are employed. The spherical guides are also worthy of notice. The lateral guides are formed of flat pieces of wood, which are arranged on each side of the saw so that they can be closed up to the saw-blade and adjusted to compensate for the wear. The back-thrust guide consists of a series of finely turned and hardened steel balls, and steel washers of the same diameter as the balls, having a hole drilled through the centre, the balls and washers lying on each other alternately in a cylindrical enclosure drilled into the cast iron, which forms the support for the lateral and the back-thrust guides. A groove of the proper width is cut lengthwise through the cylinder, so that the back of the saw comes in contact with the balls, and as the balls rest only on the edge of the small holes drilled through the supporting washers, the balls can all be brought forward and adjusted to a perpendicular line established by the back of the saw-blade; the saw-blade, when passing downward, will cause the steel balls to revolve sufficiently to prevent the cutting of the saw-blades into the balls. The adjusting screws behind the balls, which support and hold the balls against the pressure of the blade, have the points coming in contact with the balls arranged a very little excentric, which will cause them to revolve irregularly, presenting gradually the whole surface of the ball to the support of the blade. A series of hardened balls give a long support to the back of the saw-blade; and they support the blade very close to the material operated upon, and, on account of their rolling, resist the abrasion of the passing saw-blade very effectually. Further, a cutting over the whole surface of the ball in one line cannot take place, as it revolves irregularly, in consequence of the excentrically bearing back-screw."

The best English makers produce band-saw machines which cut wood or metal most rapidly and exactly, and for general work they leave nothing to be desired; but they require to be very carefully made, especially as regards the supports of the saw and the means of lubrication, and they are consequently expensive machines. Again, a band saw will not work long over pulleys which are less than thirty inches in diameter: the saws soon break with smaller pulleys, and rebrazing them is a delicate process and requires special apparatus. Moreover, the endless saw cannot be introduced through holes in the work. For all these reasons band-saw machines are not adapted for small fancy work. For the latter another machine is used called the scroll or fret-saw machine. Figs. 7 and 8 represent reciprocating fret-saws made by Messrs. Ransome. Fig. 7 represents a fret-saw machine with strained saw capable of doing the finest ornamental work, or of sawing through any kind of timber up to six inches thick. The apparatus for straining the saw, which is carried by an overhanging arm cast on the main framing of the machine, is very simple, consisting merely of a lever to the long end of which the saw is attached by an improved clip, which admits of it being rapidly fixed and released. To the short end of the lever is attached a very powerful spring tending to draw it downwards, and as the saw end of the lever is eight times as long as its spring end, the movement of the spring is only one-eighth as much as that of the saw. By

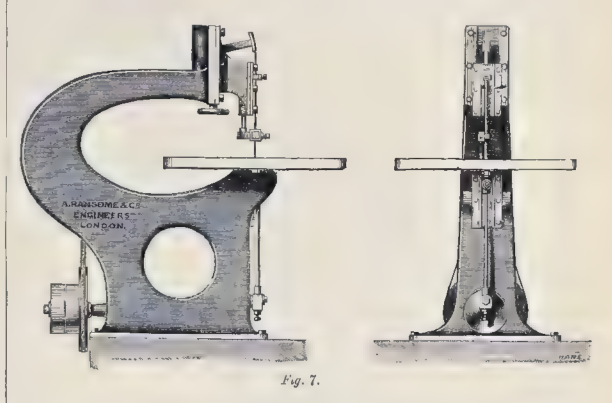


Fig. 7.

this arrangement the tension caused by the spring is practically the same throughout the entire stroke of the saw, and the wear on the spring is infinitely less than if it were attached direct to the saw, as is frequently the case. The table, which is planed all over, can be set at any required angle for bevel cutting, and the whole of the working parts being very light, the machine can be driven at a very high speed.

Fig. 8 represents a fret-saw machine with suspended saw guides and unstrained saw. For some descriptions of fret work it is an advantage to work the saw without straining it, the top being merely supported in an improved guide so constructed as to prevent the saw from yielding to the

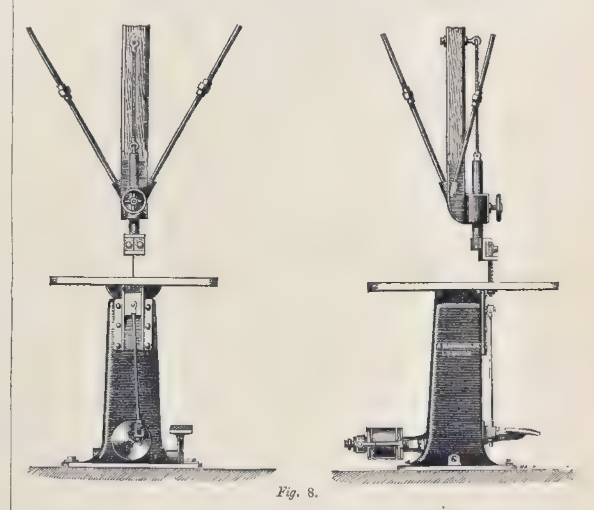


Fig. 8.

pressure of the wood against it. This construction offers the advantage of cheapness and simplicity, and as it admits of the working parts being very light the saw can be driven at a very high speed. The saws employed in these machines must necessarily be somewhat stouter than those which are strained, and they are not so well adapted for very fine work as the last-described machines; but for the reasons above given, and for the rapidity with which the saw can be withdrawn and entered in a fresh place, they are strongly recommended for work not requiring the highest finish.

No. 3.—PAPIER-MACHÉ, CARTON-PIERRE, JAPAN AND LACQUERED WARE, AND VARNISHES.



HESE articles, although very dissimilar one from the other in some respects, are also connected together: carton-pierre is papier-maché with a difference; and unvarnished japan ware differs from papier-maché in this respect, that one is made of metal, the other of paper—but the surface in each case is produced by the same means; lacquering differs from japanning in this, that the latter is fixed by heat, japan-work being consequently more solid and applicable to many useful purposes, while lacquer is much more delicate and ornamental.

Of all these productions carton-pierre and papier-maché only enter into construction, in which they are extremely useful and ornamental, taking the form of the moulds in which they are pressed with admirable sharpness, thus producing beautiful ornaments, and being not only much lighter than plaster, but fibrous and therefore much less brittle. Carton-pierre has been used very largely in France for many years—half a century perhaps, but not so long in England, where it has now been for several years applied with much skill and taste. The simplest form of producing a material for decorative purposes from paper is the best—namely, the laying of sheet after sheet upon the object to be modelled, a coat of glue being given to each sheet. In this way are produced toy masks, and, particularly, those grotesque, gigantic specimens which figure in our pantomimes. The process is simple: a mass of clay is laid upon a board and shaped by the fingers and thumb, with the aid of a few simple wooden modelling tools, into the face of a giant or other comic personage, and when finished is gradually dried; sheets of soft porous paper are then laid one at a time upon the clay and rubbed over with glue, the brush pressing the paper into all the indentations of the model; when the mask is of sufficient thickness the face of it is coloured and varnished in the brilliant manner so highly appreciated in our boyish days. As an instance of the curious connection of the arts, it may be mentioned that this very process, which has for years produced the grotesque pantomimic masks, has lately been applied to the copying of ancient inscriptions and ornaments. Soft paper and paste are the materials here used, and the paper impressed with the indentations of the work to be copied by means of a brush or of tools made of soft wood shaped for the special purpose: the mould thus taken is not sharp, and is only suitable for very low reliefs; but the process has great recommendations—it enables a traveller to collect moulds of objects which occupy little room, are very light in comparison to plaster, and not brittle. Some excellent moulds have been produced in this manner, but the process can only be considered as a make-shift. In a modified form it is also used for taking moulds from type for casting.

Another method has lately been employed for the decoration of the ceilings of the Exhibition building in Paris: it is known as the *Châssis de staff* method, and consists of steeping tow in plaster and then moulding it. This mode produces light casts.

Carton-pierre ornaments are made of paper pulp mixed with whiting and glue, cast in plaster moulds, and dried gradually in a hot room. It is admirably adapted for large decorations, on account of its lightness and durability. Still better than carton-pierre are the papier-maché ornaments which have been produced for the last thirty years in this country. They are made of sheets of paper in the manner described in the following extract:—"It is prepared by laying sheets of brown paper one over the other, a coat of glue being given to each; and then pressing the mass into metal moulds, and afterwards trimming the edges to shape; the paper is now withdrawn from the mould, into which a mixture of pulp, resin, and glue is introduced; over this the paper already referred to is laid, and pressed with great force into the mould; by this method a tough foundation and a fine face are produced. Some excellent examples of carton-pierre and papier-maché ornaments by Messrs. Jackson and Sons and Mr. Bielefeld, both of London, will be found amongst our illustrations. Works of considerable size have been produced by this method, such as panels for cabins of steamboats, vehicles, and even railway carriages, the material being susceptible of any amount of decoration and of the most brilliant finish. In Berlin, and probably elsewhere, carton-pierre has been applied to the production of statuettes and other sculpture."

Papier-maché goods are produced also by pressing the pulp of paper between dies, as well as by pasting sheets on models. The articles when dry are varnished, japanned, and ornamented. By the first method a variety of cheap work is manufactured in Paris; the materials for the pulp—viz. paper and paste—being supplied by the bill-stickers, whose bills, having served the purposes of advertisements by day, are by night pulled down and taken to the factory, *mashed* in water, and pressed in moulds. The second method is the superior of the two, and is thus conducted at Birmingham: "Paper of a porous texture, saturated with a solution of flour and glue, is applied to an iron, brass, or copper mould of somewhat smaller size than the object required: repeated layers of this paper are put on with glue, a drying heat of 100° being applied after every new coat. When a sufficient thickness is attained, the shell is removed from the mould, and planed and filed to shape. About ten layers are used for an ordinary tea-tray; more or less for other articles, according to circumstances. A tar-varnish mixed with lamp-black is next laid on, and the article is stoved. Several coats of varnish are added, with a stoving after each. When sufficiently covered with this preparation, the inequalities are removed with pumice-stone, and the artist applies the ornament in bronze-powder, gold, or colour. Several coats of shell-lac varnish are then put on, and the article is stoved at a heat of 280°. The article is polished with rotten-stone and oil, and brought to a brilliant surface by hand-rubbing."

For such articles as tea-trays, waiters, paper-cases, pen-trays, &c., the superior kind of papier-maché is admirably adapted; the body of the paper is so completely permeated by the tar varnish that it is never attacked by insects; it never warps; the heat to which it is subjected renders the surface almost as hard as enamel; it takes any kind of ornament readily, and it is the lightest substance in use for similar purposes, if we except some of the excellent wood used for small articles by the Japanese. When finished with care and decorated judiciously such papier-maché articles are equally elegant and durable. A few gold lines, simple borders, or other ornaments, treated in the flat inlaid style, are all that are required to lighten up the beautiful black polished surface for which English—that is to say Birmingham—papier-maché is unequalled. Unfortunately papier-maché is decorated with dangerous facility, and the want of artistic education in the public as well as in the manufacturers of such goods gave rise to an exuberance of ornamentation which happily has at last been nearly annihilated by its own extravagance. The use of glaring colours, glittering metal foils, mother-of-pearl, gold, and other means of ornamentation, had reached such a pitch that, with the exception of such fine plain articles as we have spoken of, the home demand for papier-maché almost ceased—an example of a most useful manufacture ruined by bad taste. There are more than a thousand persons, about half women, employed in this trade at Birmingham, but principally for the export trade.

The best kind of ornamentation applied to papier-maché is perhaps that which is common to China and Japan, the production of designs in various tinted gold and bronze powders, with the figures raised, modelled on the ground of the work in whiting and size, or merely painted in gold size; but this former requires great skill and experience, and few even amongst the most artistic attain mastery over it: the same operation produces the beautiful figures in relief on china, the process being called *pâte-sur-pâte*—the same, in fact, as that which artists call impasto—paste on paste, colour on colour. The production of figures in gold and bronze requires good drawing only—not too common an accomplishment. An artist named Booth, who worked for Messrs. Jennings and Betteridge, exhibited so much talent in the impasto style half a century ago that his reproductions of Chinese and Japanese ornamentation deceive the best judges.

Another kind of decoration, also most appropriate to the material, requires little artistic talent, only clever manipulation and experience, and the best makers of papier-maché articles in Birmingham are unrivalled in such work. This consists of decoration with plain lines, simple borders, and geometric patterns, produced with the aid of gold and bronze powders, and mother-of-pearl, green-shell, and some other brilliant substances cut into thin slips, and used with great moderation. Very beautiful work of this kind is to be found, and deserves attention; but the florid decoration of common papier-maché goods, paint and gold upon mother-of-pearl and

tinfoil, without art, or taste, or even cleverness, must be classed amongst the most wretched instances of misspent labour.

With the exception of the raised figures, of which we shall have to speak again, and that of decorating with the brush, the mode of decorating papier-maché—inlaying, as it is invariably called—is always the same. The mother-of-pearl, or whatever the material employed in the ornamentation, is simply stuck on the partially finished surface with copal varnish, and when all the pieces of the ornamentation are in place sufficient tar varnish is added to raise the surface quite up to that of the pearl, &c.; then, after stoving, the varnish is rubbed down until the ornaments are brought to view, the work is finished off, and the last artistic touches given by hand.

Those who like to try their hands at the decoration of papier-maché may purchase blanks—undecorated articles—for the purpose. There have been many improvements introduced in the trade, such as steaming the blanks, and submitting them to great pressure, which gives the body perfect solidity and equal thickness throughout. Then, in the way of ornamentation, thin slices of precious stones, and even gems, and coloured glass, ornaments produced by the electro process, mother-of-pearl and other materials behind glass, aluminium, and many other things have been employed; and photographs, chromolithographs, and other forms of printing in gold and colours have been called into request.

The production of papier-mache originated in the far East, where it is still cultivated with much taste and ability, the Japanese and Chinese art-workmen seldom committing the glaring errors to which we have had to refer above. In the best shops of all the towns in Great Britain may be seen examples of admirably decorated Eastern papier-maché.

The trade in japanned goods made of iron-plate is a very large one in this country, as every house and shop will testify: the principal seat of this manufacture is Wolverhampton, where a large number of persons are employed in making and decorating tea-trays, coal-scuttles, and other japan ware. These articles are much cheaper than japanned papier-maché, but not so light, so durable, or presenting so beautiful a surface; but they are most useful articles and capable of good decoration, and it may be mentioned with honour of one of the best decorative artists England ever produced, Owen Jones, that it is within our own knowledge that more than twenty years ago he did not disdain to aid the superior japan trade in Wolverhampton by producing some designs for it of an admirable character.

The method of japanning metal ware differs little from that applied to papier-maché, and we cannot perhaps do better than quote the following article on the subject from Professor Tomlinson's "Cyclopædia of the Useful Arts and Manufactures." "For black japanned works, the ground is first prepared with a coating of black, consisting of drop ivory-black mixed with dark-coloured animé varnish. This coating is well dried in a stove, and then varnished three or four times, the work being well dried between each. If coloured grounds are required, one or two thick coats of colour mixed with varnish are first laid on, and several varnishings and dryings complete the work. The ordinary painter's colours, ground with linseed-oil or turpentine, and mixed with animé varnish, enable the workers in japan goods to produce a variety of effects according to their taste and fancy. The articles may be black or brown with gilded edges, or they may imitate marble, fine-grained wood, or tortoiseshell, the last named being produced by vermilion with a varnish of linseed-oil and umber. The colours most in request for this kind of work are flake-white or white-lead, Prussian-blue, vermilion, Indian-red, king's-yellow, verdigris, and lamp-black, with numerous intermediate tints produced by their mixtures. The varnishes employed are copal, or a varnish composed of seed-lac, or of gums animé and mastic. The lac varnish is the best as it respects hardness, but is too high coloured to be used alone on the more delicate grounds: it is therefore mixed, for such purposes, with gum varnish, or it is superseded by copal varnish. Copal or animé varnish made without driers is applied two or three times, or as many as five or six times to the best works, to protect and give brilliancy to the colours.

"It frequently happens that the articles to be japanned are either too coarse and soft to receive the lacquer, or their substance is not sufficiently smooth without priming and preparation. Perhaps every workman has his own favourite method of preparation, and of mixing his varnishes; but it must be remarked that, whatever the care employed, works executed on an artificially prepared ground can never be depended on for durability, being much more liable to crack than those which are lacquered on the solid substance of the object itself. The priming is of size and chalk or whiting, mixed up to a proper consistence to be laid on with a brush. It should be left a day or two to dry, and then brought to a proper smoothness of surface by rubbing with rushes, and then by the application of a wet cloth. When thoroughly dry the grounds are laid on smoothly with a brush, and finished by varnishing and polishing with rotten-stone, or if the ground be white with putty or starch and oil. A brilliant ground is sometimes formed by laying it entirely in gold. This is done by going over the work with japanner's gold-size, and when this is nearly dry but still clammy, it is covered with gold-dust, applied on a piece of wash-leather. This when highly varnished has a very splendid effect. Ladies' work-boxes, work-tables, &c., are frequently ornamented with engravings or drawings transferred to the japan work. For this purpose the engraving is printed, or the drawing made on fine paper which has been previously prepared with a coat of isinglass or gum-water. This, when dry, is applied with its face downwards upon the japan ground, covered with a thin coat of copal varnish; the paper is then moistened on the back with a sponge dipped in warm water, which soon dissolves the isinglass or gum, and the paper being loosened can then be taken away, leaving the print on the work. Or a print may be executed on an elastic composition of glue, &c., which receives the impression as well as paper, and may be immediately laid down upon the japanned surface, which will thus receive a perfect impression. All the processes connected with japanning require so much drying between them, that it is very desirable to hasten the work by means of stoves.

"Common articles of furniture, such as dressing-tables, chairs, wash-stands, &c., are frequently said to be japanned, implying a greater durability than ordinary wood-painting; but the chief difference seems to be that the colours employed in painting them have been mixed with turpentine instead of oil."

Of all the lacquered work produced, that executed by the Japanese on wood is the most beautiful and the most costly. Every one who has visited one of our great exhibitions, or any important collections of curiosities, must have been struck with the beauty and finish of the lacquered cabinets, trays, boxes, and various other articles produced by that people: as curiosities they have always been in demand, and artists and manufacturers have always recognised the perfection of manufacture, the finish, and the admirably consistent decoration which characterizes these productions.

Lacquer derives its name from the Indian word *lac*, the product of the same insect which yields the beautiful colour known as Indian-lake, and which belongs to the same family as that which yields cochineal. Lac is, in fact, the resinous essence of a tree produced by this insect, the *Coccus lacca*, which punctures the tree on which it lives. Lac is largely used in producing varnishes and sealing-wax. The purest form of it is shell-lac, of which the true lacquer is made, the lac being dissolved in spirits of wine. That for wood, called *hardwood* lacquer, may be in the proportion of 2 lbs. of lac to the gallon. Another receipt is 1 lb. of seed-lac and 1 lb. of white resin to a gallon of spirits of wine. For brass the proportions are ½ lb. of pale shell-lac to one gallon of spirit. It should be made without heat, and simply by agitation for five or six hours. It should then be left until the thicker portions have subsided, when the clear lacquer must be poured off, or, if not sufficiently clear, it must be filtered through paper. It darkens by exposure to light, so that paper should be pasted round the bottle to exclude it. A pale yellow lacquer may be prepared from 1 oz. of gamboge and 2 oz. of Cape aloes, powdered and mixed with 1 lb. of shell-lac. For a full yellow, ½ lb. turmeric and 2 oz. of gamboge; for a red lacquer, ½ pound of dragon's-blood and 1 lb. of arnotto. The colour, however, is modified by that of the lac employed. Lacquers may also be coloured by dissolving the colouring matters in spirits of wine, and adding the proper proportions of these to the pale lacquer according to the tint required. Mr. A. Ross prepares lacquer with 4 oz. of shell-lac and ¼ oz. of gamboge, dissolved by agitation in 24 oz. of pyroacetic ether. The clear liquor is decanted, and when required for use is mixed with eight times its volume of spirits of wine.

In the case of thin circular work, such as small trays, which the Japanese produce with a degree of thinness and regularity which is remarkable, the friction of polishing supplies the heat required for the process, the lacquer being laid on coat after coat thinly and evenly with the aid of a camel-hair brush; this and the subsequent polishing are often done on the lathe most effectively.

In the report of the Great Exhibition, 1851, Professor Roesner, chairman and reporter of the jury of Class XXVI., says:—

"Lac is the sap of a shrub called tsei-shoo (*Rhus vernix*) in Japan, and of the *Augra Sinentis* in China; the juice is of a poisonous nature, and great caution is required in collecting it." The professor then gives, on the authority of M. Natalis Rondot, a member of the jury, the following account of the method of applying the lacquer:—"The article to be ornamented, if formed of wood, is always very dry, light, and smooth: it is first coated with a preparation of ox-gall and rotten-stone; this is rubbed to a smooth face and then varnished. This varnish is thus composed; 605 grains of fine gum-lac are put in 1,200 grains of water; to this is added 38 grains of oil of Camellia Sasanqua, a pig's gall, and 16 grains of rice vinegar. The whole is well mixed in full daylight, the lac gets deeper and deeper, and the varnish shortly becomes a brilliant black; a very thin coat of this is laid on with a flat hair-brush. The article is left in a steamy heat, and at length comes into the hands of a workman who rubs it down in water with very fine pumice. The work then receives a second coat of the lac varnish, and after that a second polishing, and these two operations are successively continued till the surface is perfectly even and brilliant.

As the operation advances, a still finer quality of lac is used: there are never less than three coats laid on, and sometimes as many as eighteen. The decoration of the object is confided to an artist-workman, who first draws in the design with white lead; if he is satisfied with the sketch, he engraves it and fills in the thousand little details of the subject." (The word engraved is probably an error of translation.) "There then remains only to paint with the camphorated lac of Konang-Si, which serves as a mordant on which to gild either with leaf-gold or powder. The reliefs are obtained by one or two coats of koa-kinn-tai, and these gilt designs are then enriched with the lac of Fo-kienn." "Little is known of the fine lacs of Sou-tchon and of Nankin: the price is very high; this is explained by the cost of the work which requires the application, the hardening, and the polishing alternately, of eighteen or twenty coats. In thin lacquered objects the purity and brightness of the varnish, the infinite minuteness of the decoration, and the finished workmanship of the furniture are most admirable. In the work from Japan pieces of mother-of-pearl cut to form are inlaid in the lacquered grounds, and the last coats of the varnish are polished with a reed."

It is interesting to study the means and processes by which the originators and, to the present time, most famous makers of this beautiful lacquer produce those elegant cabinets and other objects which are the admiration of connoisseurs, and we shall borrow some notes from the work of M. Paul Campion, a French chemist, who visited China with the especial object of studying the modes of manufacture in use there, and collected a large amount of industrial and scientific information which he embodied in a small work on the industries of that empire, published in the year 1869.

According to M. Campion, the Chinese and Japanese varnish is derived from a tree whose botanical name is *Rhus vernicifera*, common to both countries, and that the varnish is superior to any known to European manufacturers. At a certain time of the year a hole is made in the lower part of the trunk of the tree, into which a piece of bamboo is fitted and a viscous fluid soon begins to drop from it, which is used without any preparation for varnishing furniture. This varnish is produced in almost every province of China, but that of Japan is the most esteemed. There are several varieties of the tree in question which produce varnishes ranging from dark yellow to black. We may mention here that the fine tree, the ailanthus, which is now largely cultivated in this country, and still more in France, is in the latter country commonly called the *Vernis de Japon*; but this is an error, and arose out of the mistake of an official who was not a botanist. The sap, or varnish, has a powerful effect on the skin, and the vapours which it emits are so caustic that the men who collect it are compelled to take the greatest precautions against its effects, and many artisans are compelled to give up the business in which it is employed on account of the painful ulcerations which it frequently produces. In order to test the quality of the Japan varnish, a piece of bamboo is dipped in it, and if the juice dries quickly and of a blackish colour, it is considered good. Some experiments were made in Paris with this varnish by M. Campion and two other chemists, and one of the latter was so affected by the fumes that he was compelled to keep his bed for some days. Amongst the best preventatives found against these ill effects was heavy oil containing camphor in solution. The varnish is very dear, a very small quantity having cost M. Campion about twelve shillings in Han-Keou. The natural varnish is used in many ways according to the circumstances of the case: raw, boiled, and mixed with drying oils, and colours such as lamp-black and vermilion; but its most important application is that of the manufacture of lacquers.

Articles to be lacquered have their surfaces made as smooth as possible, any imperfections or joints that may exist being carefully filled with a mixture of clay and size dissolved in water, so that when dry it may form a perfect face with the wood. When this preparation is accomplished, the work is covered with boiled varnish, mixed either with red or black pigment. The varnish is laid on with a peculiar brush, which is formed of two thin pieces of soft wood about two inches wide, between which are glued very strong horse-hair: this brush is cut, as it wears like our lead-pencils, and the hair is only allowed to protrude to a short distance, so that the brush is very hard. As soon as the first coat is dry, another is laid on, until the desired thickness of varnish is obtained. In some cases, before the first coat of varnish is laid on, the wood is entirely covered with a mixture of clay and size, laid on in one or more coats and allowed to dry, when it is very carefully rubbed down with fine pumice. When figures in relief are to appear on the work, these are modelled in their place in the same composition of clay and size, and they are then covered with tinfoil, gold-leaf, or thin pieces of mother-of-pearl, and finally varnished. The Chinese say that lacquer-work can only be executed with success during the rainy season, and that it is not attempted at other times. M. Campion is of opinion that lacquer-work like that of Japan cannot be produced in Europe, but consoles himself with the fact that another deleterious employment cannot be added to the many that already exist.

Before quitting the subject of Chinese and Japanese varnish, we will borrow another paragraph or so from M. Campion's work. There is a tree, he says, the *Vernicia montana*, the seeds of which produce oil that makes very valuable varnish, which mixed with resin is used for boots and for rendering articles waterproof. The seeds are squeezed in a press, and the oil is then moderately heated with a mixture of red-lead, alum, and steatite (soap-stone), when a sirupy paste results, which is heated till it is sufficiently thick to bear a rush stuck upright in it. While still warm, this varnish is coloured as desired with lamp-black, cobalt, cinnabar, white-lead, or gum-gutta. It requires to be kept in well-closed vessels in a damp place, or even in water.

Visitors to South Kensington have now the opportunity of examining a splendid collection of decorated manufactures of all kinds, including not only lacquered ware, but china, bronzes, ivory, and other work, made expressly by the Japanese Government for the museum. There is, amongst other examples, a large cabinet or shrine of the finest lacquer, which is almost an exhibition in itself.

Besides japanned and lacquered ware, there are many articles which are varnished or lacquered, and for such purposes a variety of gums and resinous substances are employed in a hundred different forms and manners. The following account of the various kinds and of the modes of preparation cannot fail of interest.

"The principal substances used in varnishes are the following:—

Solvents.	Solids.		Colours.	
Oil of Nuts.	Amber.	Elemi.	Gamboge.	Arnotto.
„ Linseed.	Animé.	Benzoin.	Dragon's blood.	Red Saunders.
„ Turpentine.	Copal.	Colophony.	Aloes.	
„ Rosemary.	Lac.	Arcanson.	Saffron.	
Alcohol. Ether.	Sandarach.		Turmeric.	
Wood naphtha or pyroligneous ether.	Mastic.		Cochineal.	
	Damar.		Indigo.	
	Common resin.			

"The resins, or, as the varnish-maker calls them, *gums*, may be used either singly or combined, and the same remark applies to the solvents. One of the most desirable qualities in a varnish is durability, a quality which depends greatly on the comparative insolubility of the resin employed, its hardness, toughness, and permanence of colour. *Amber* is most distinguished in these respects: it resists the action of ordinary solvents, and requires to be fused at a high temperature, for making varnish; it is hard, and moderately tough, and its colour is scarcely acted on by the air. The objections to amber are its costliness and the length of time required for amber varnish to dry: it does not become full hard under many weeks. *Animé* is imported from the East Indies in chests weighing from 3 to 5 cwt. Those which contain the palest and largest gum fetch the highest price. It should be scraped by hand before being sold, but a good deal of it is *pickled*, that is, cleaned from its rust-like colour, by being steeped for several days in a strong alkali, well washed with a broom and then rinsed with water. This kind sells for about one-third less than that which has been scraped with a knife. The varnish-maker picks out the large, pale, transparent pieces, or they are sold separately as *body-gum*; the next best in quality is separated from the third and worst quality, which is used for gold-size or japan-black. Animé is almost as insoluble and hard as amber, but not so tough: the varnish made with it dries quickly, but is liable to crack, and the colour deepens by exposure to air and light. Anime is largely used in oil varnishes, and there is a large proportion of it in *copal varnishes* on account of its drying quickly. *Copal* is produced in India, America, the West Indies, Sierra Leone, &c. Dr. Lindley says that 'the copal of Madagascar, and probably of the East Indies generally, is furnished by *Hymenæa verrucosa*,' that '*Vateria Indica* furnishes the resin called in India *copal* (in England known by the name of *gum-anime*), and very nearly approaching the true resin of that name: in its recent and fluid state it is used as a varnish (called *Piney* varnish) in the south of India, and, dissolved by heat, in close vessels, is employed for the same purpose in other parts of India; it is extremely tenacious and solid, but melts at a temperature of 97½° Fahr. Dr. Wight tells us that the natives obtain it by the simple process of cutting a notch in a tree, sloping inwards and downwards: the resin collects there, and soon hardens.' Copal is generally imported in lumps about the size of small potatoes, of a slightly yellow tint, and often including insects and animal remains. It is often covered with a clay-like substance, from which it is freed by the dealers by scraping. The finest and palest lumps are selected for what is called *body-gum*; the next best form *carriage-gum*; and the remainder, being freed from wood and stones, forms what is called *third*, or *worst quality*, and is used for gold-size or japan-black. Copal has a conchoidal fracture; it is transparent, inodorous, and tasteless. Its density varies from 1·045 to 1·139. It softens by heat without becoming viscid, and at a higher temperature fuses, partly decomposes, and gives off an aromatic odour. Copal is next in durability to amber: the pale specimens, when made into varnish, become lighter by exposure. It is an excellent material for varnishes, and attempts

have been made to use it as the basis of a spirit varnish; it is, however, so little soluble in alcohol, that when boiled therein, only a small portion dissolves, and the remainder swells and softens. It is said, however, that by reducing copal to an impalpable powder, and exposing it for about twelve months to the action of the air, it becomes soluble in alcohol, and may be used for preparing varnishes. The addition of a small quantity of camphor increases the solubility of copal in alcohol; the same effect is produced by fusing it, setting it on fire, and allowing it to burn a few minutes: these and similar plans, however, produce a very inferior varnish. Oil of rosemary is said to be one of the best solvents of copal: ether is probably the best solvent, but it evaporates so rapidly, that the varnish cannot be spread equally. The oils of spruce and lavender have also been used as solvents.

"The three resins, amber, animé, and copal, either separately or mixed in certain proportions, are converted into varnish by fusion and the addition of linseed-oil heated nearly to its boiling point: the combination of the resin with the oil is promoted by stirring and boiling, and the required degree of fluidity in the varnish is attained by the addition of oil of turpentine. These are the most important of the *oil varnishes;* they are the most durable, they are hard enough to bear polishing, and they possess considerable brilliancy.

"They are used for works of the best quality, such as are exposed to the weather or to much friction, as carriages, japan-work, and house decorations.

"*Lac* and *sandarach* form the basis of *spirit varnishes:* these resins are more soluble than amber, animé, and copal; they are dissolved in spirit of wine, or pyroxylic spirit, which is cheaper. In France, where alcohol is very cheap and abundant, spirit varnishes are largely employed. They are used for cabinet and painted works not exposed to the weather. Lac is harder than sandarach, and is the basis of most lacquers and also of French polish. Sandarach is used for making a pale varnish for light-coloured woods: it may be hardened by the addition of shell-lac or mastic if required to be kept pale; and when required to be polished, Venice turpentine is added to give it body.

"*Mastic* is a soft resin: dissolved in spirits of wine or oil of turpentine it makes a very pale varnish; it is brilliant, works easily, and flows better on the surface than most other varnishes. It can also be removed by friction with the hand, hence its use as a picture-varnish and for other delicate works.

"*Damar* is softer than mastic: it forms an almost colourless varnish with turpentine: mixed with mastic it forms a moderately hard, flexible, and almost colourless varnish adapted for maps and similar purposes.

"*Common resin,* dissolved with the assistance of heat in turpentine or linseed-oil, makes a hard, brittle, brilliant varnish, which is employed for common purposes, as in house painting, toys, cabinet work, &c. It improves the brilliancy of other varnishes, but renders them brittle unless used sparingly.

"The *linseed-oil,* used as the vehicle for the harder resins, should be pure, pale, well clarified, and combined with the resin at as low a temperature as possible. Unless these conditions be attended to, a dark varnish is produced which becomes darker by age. This oil gives softness and toughness to the resin, but produces a slowly drying varnish. It is clarified for the best varnishes by being gradually raised to near the boiling-point in a copper pan, Fig. 1. About two hours should be occupied in attaining this temperature: it is then skimmed and left to simmer for about three hours longer. About ¼ oz. of dry magnesia per gallon of oil is then gradually stirred in: the heat is kept up for another hour, and the whole is then left to cool very slowly. After this it is transferred to lead or tin cisterns, and left tranquil for about three months, when the magnesia combines with the impurities of the oil and subsides. The clarified oil is drawn off from above, and the lower portion is used for black paint. A pale drying oil may be prepared in this way by substituting for magnesia, 2 oz. of white copperas (sulphate of zinc), and 2 oz. of sugar of lead, to every gallon of oil. Linseed-oil, converted into a drying oil by boiling and adding litharge and red-lead, is sometimes used as a cheap varnish. The linseed-oil is raised to the boiling-point in about two hours, and after skimming, about 3 oz. each of dry litharge and red-lead per gallon of oil are slowly sprinkled in, and the whole is boiled for about three hours, or until little scum is formed or much smoke emitted. The varnish-maker judges whether the oil be properly boiled by dipping the end of a feather into it; if it be burnt off, or curl up briskly, the boiling is sufficient. The oil is then left to cool very gradually, during which the larger portion of the driers subside. The oil is preserved in close leaden cisterns. For a pale oil the driers are white-lead, sugar of lead, and white copperas.

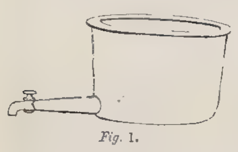


Fig. 1.

"*Turpentine* is in extensive use for varnishes, either as a vehicle for the resins or for thinning oil varnishes, in which case it is used hot. The turpentine should be of the best quality, clean and limpid; it is greatly improved by age, and should be kept for months or even years. Turpentine varnishes are cheap and flexible; they dry more quickly than oil varnishes, and are of a lighter colour, but not so tough or durable. Mastic, damar, and common resin may be dissolved in oil of turpentine either cold or at a gentle heat.

"*Alcohol* or *spirits of wine* is used as the vehicle for sandarach and shell-lac, as in the *white* and *brown hard spirit varnishes.* Spirit varnishes dry more quickly, harder and more brilliant than those made with turpentine. The spirit must contain very little water, or it will not dissolve the resins; and in applying the varnishes a moderately moist atmosphere is sufficient to occasion such a precipitation of the resins as to produce a dull, cloudy, or milky effect on the varnished surface; in which case the varnish is said to be *chilled.* The varnish-maker ascertains whether the spirit is strong enough by dipping a piece of writing-paper in it and setting it on fire; if the flame consume the paper, the spirit is judged to be sufficiently strong; if not, it contains too much water.

"*Naphtha* or *pyroligneous ether* is objectionable on account of its smell, but is used for cheap varnishes. It dissolves the resins more readily than ordinary spirits of wine, but the varnish is not so brilliant. Methylated spirits, petroleum, and kauri are much used in varnish making; petroleum is used on account of the scarcity of turpentine.

"Considerable heat being required in the preparation of oil varnishes, and the materials employed being very inflammable, the factory should be detached from other buildings and constructed for the purpose. Directions respecting the structure of the buildings, the utensils, &c. required, and the processes adopted in the manufacture of varnishes, are given by Mr. J. Wilson Neil in his Essay contained in the 49th vol. of the 'Transactions of the Society of Arts.' Mr. Neil was presented with the Society's Gold Isis Medal for this Essay, to which we have been considerably indebted in the preparation of this article.

"The copper used for the purposes of boiling oil, gold-size, japan, Brunswick black, &c., is called a *set-pot,* and is represented in Fig. 2, with the flue winding round it. The *gum-pot,* in which the resins are fused, is set in a small furnace as shown in Fig. 3. The gum-pot is of copper 2 feet 9 inches high, and 9½ inches diameter. The lower part *a* is raised out of one piece; the upper part *b* is of sheet copper, cylindrical, 10 inches diameter at the top and 2 feet 2 inches high, and is attached by rivets to the lower part or bottom *a;* but before riveting, a flange of copper is fixed just below the large rivets; an iron hoop *d,* with an iron handle, is also attached to the cylinder. A copper *boiling-pot,* shown in elevation and plan, Figs. 4 and 5, is required; the bottom, shown by the dotted lines, is raised out of the solid, and is 7 inches high and 20 inches in outside diameter; the cylinder or body of the pot is 2 feet 10 inches high, and is well riveted to the bottom, the rivets being hammered inside and out so as to project and support the pot and its contents instead of a flange. The pot is made to fit neatly into a hole in a plate of iron, Fig. 6, which covers the top course of the brickwork. The cylinder has a strong handle on each side.

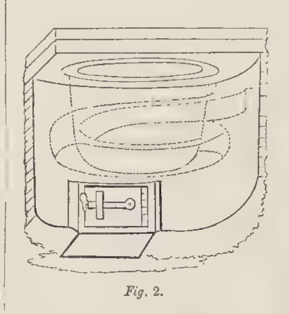


Fig. 2.

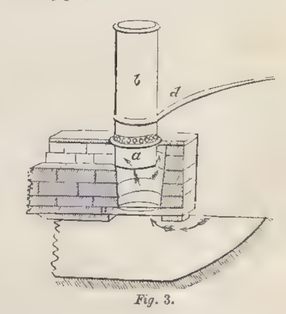


Fig. 3.

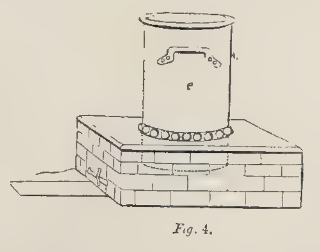


Fig. 4.

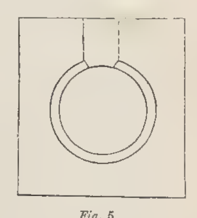


Fig. 5.

"The utensils required are ladles, stirrers (of the form shown in Fig. 7), and funnels of copper; an oil-jack, Fig. 8, of the capacity of 2 gallons, for pouring in hot or boiling oil; a brass or copper sieve, 60 meshes to the inch and 9 inches diameter, for straining the varnish; a brass

sieve, 40 meshes to the inch, 9 inches diameter, for straining gold-size, turpentine, varnish, boiled oil, &c.; and a similar sieve for straining japan and Brunswick black; a saddle, Fig. 9, or sheet of tinned iron 12 inches

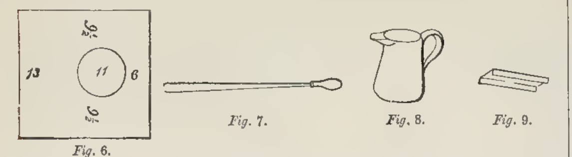


Fig. 6. *Fig.* 7. *Fig.* 8. *Fig.* 9.

broad and turned up 1½ inch; it is placed between the edges of the set-pot and the funnel to receive the drops of varnish spilled during the taking out. A pot like a watering-pot without a rose is used for pouring oil of turpentine, and there are a few other articles which do not require particular notice.

"For making varnish on a small scale a gum-pot similar to that shown in Fig. 3, or smaller, may be used; also an iron tripod with a circular top into which the gum-pot will easily fit. The operation may be conducted in a hollow in a field, yard, or out-house, and a temporary fire-place be raised round the tripod with loose bricks similar to a plumber's furnace; the fuel to be preferred is coke or charcoal. When the fire burns with a strong heat, set on the gum-pot with 3 lbs. of copal in it. The fire should not rise higher outside the pot than the depth of melted copal, or the resin is likely to catch fire. As soon as the copal begins to fuse it should be constantly moved about and divided with the copper stirrer; if it feels lumpy and rises to the middle of the pot, it must be lifted off the fire, placed upon a bed of ashes by the side, and kept stirring until the swelling subsides. The gum-pot is again put on the fire, and stirred until the resin has become as fluid as oil, which is ascertained by lifting up the stirrer so far as to see the blade. Then call out to an assistant, 'Be ready!' and he then lifts up the jack, Fig. 8, full of clarified oil, and rests the spout on the edge of the gum-pot. When the gum rises to within 5 inches of the gum-mouth, call out 'Pour!' when the oil is to be poured in very slowly, the maker continuing the stirring. In 8 or 10 minutes with a strong fire the oil and the resin will have combined into a clear varnish; this is to be ascertained by lifting up the stirrer and dropping a little of the varnish from it upon a piece of broken glass; if it be clear and transparent the combination has been effected; but the varnish must be boiled until a drop pinched between the finger and thumb will on separating them draw out into fine filaments; if not boiled enough the varnish will be soft, thick, and greasy. The string-test must be tried every minute or less, and the moment it is satisfactory the pot is removed to the ash-bed and left for 15 or 20 minutes. When cold enough for *mixing*, oil of turpentine is poured out from the pouring pot in a small but gradually increasing stream; if the varnish rise rapidly in the pot, it must be constantly stirred at the surface to break the bubbles; but the stirrer must not be allowed to touch the bottom of the pot, or the turpentine will be partly converted into vapour and cause the varnish to overflow. If, however, the varnish should rise so as to become unmanageable with the stirrer, the temperature may be lowered by means of the copper ladle, a ladleful being taken out and poured back again many times. When the mixing is complete the varnish sieve is put into the copper funnel, and this into the carrying tin, and the varnish is strained; it is emptied into jars or cisterns and left for a time, the longer the better, to settle. When taken out for use the *bottoms* must not be disturbed.

"In making varnishes on a larger scale, the boiling-pot and the gum-pot will probably have to be used at the same time. Set on the boiling-pot with 8 gallons of oil, and kindle the fire previously laid; then lay the fire in the gum furnace, and have as many 8 lb.-bags of gum weighed out as will be required: put one 8 lbs. into the pot, and kindle the fire. In about 3 minutes, with a brisk fire, the gum will begin to fuse and smoke: stir, and divide it, and attend to the rising as before. In about 20 minutes the 8 lbs. of copal will be fused into a clear liquid. By this time the oil should be brought to a simmering state as if beginning to boil; when this is the case, the maker calls out, 'Bear a hand!' and the maker and his assistant lift the boiling-pot by its handles out upon the ash-bed. The maker instantly returns to the gum-pot, while the assistant puts three copper ladlefuls of oil into the pouring-jack, which he places on the iron-plate at the back of the gum-pot to keep hot until wanted. When the gum is nearly fused the maker calls out, 'Ready oil!' when the assistant lifts up the jack to the edge of the pot, and when the maker calls out, 'Oil!' he pours it in, the boiling being continued until the mixture has become clear. The gum-pot is now set upon the stand until the assistant puts 3 more ladlefuls into the pouring-jack and 3 more into a spare tin for the third run of gum. The boiling-pot will still contain 3½ gallons of oil. The gum-pot is now raised by its handle, and the edge put over the edge of the boiling-pot, and its contents poured in. When the maker is ready for this pouring, the assistant stands by with a thick piece of wet carpet without holes, large enough to cover the mouth of the boiling-pot should it catch fire during the pouring, which sometimes happens when the gum-pot is very hot. Should the gum-pot fire it has only to be kept inverted, and it will go out of itself; but if the boiling-pot fire during the pouring, the assistant throws the piece of carpet over the blazing pot, holding it down all round the edges, and in a few minutes it will be smothered. The moment the gum-pot is emptied, half a gallon of turpentine is poured into it, and it is washed with the assistance of a broom, called a *swish*, and then emptied into a flat tin-jack: the pot is wiped dry, another 8 lbs. of gum put into it, and it is set on the furnace. This and the third run are treated like the first; when the boiling-pot will contain 8 gallons of oil and 24 lbs. of gum, a strong fire is to be kept up until a froth or scum rises and covers the surface. When it rises up to the rivets of the handles, the boiling-pot is removed from the fire to the ash-bed, and the froth stirred down. This being done, the pot is again put on the fire, and the remainder of the driers gradually introduced, always removing the pot when the froth rises to near the rivets of the handles. In about 3½ or 4 hours from the pouring in of the last gum, the boiling may be completed, but the time will vary with the weather, the quality of the oil, of the gum, the driers, and the state of the fire. About the third hour of boiling the string-test is applied: when this is satisfactory, the pot is removed to the ash-bed and the varnish stirred down until cold enough for the mixing. Five tins or 15 gallons of turpentine are gradually poured in, which will leave the varnish thick enough if the resin is of good quality and has been well run; if not of good quality, and not well fused, 12 gallons of turpentine may be too much. Therefore, after the introduction of the latter quantity, a portion of the varnish should be cooled in a saucer. It will be seen in a few minutes whether it will take more turpentine. The varnish is lastly strained and stored away. The boiling-pot, ladles, stirrers, and funnel must be cleaned with the turpentine used in washing the gum-pot. This turpentine is first poured into the boiling-pot, and the swish is used to wash the varnish from the sides. A large piece of woollen rag is next to be dipped into pumice powder, and every part of the interior of the boiling-pot washed and polished therewith. The ladle and stirrers, &c., are similarly operated on, and rinsed in turpentine washings, and lastly in clean turpentine, and then wiped dry with a clean soft rag. The sieve is to be kept in turpentine, which will prevent it from gumming up.

"The above directions mostly apply to the making of all sorts of copal varnishes. The proportions of oil, gum, &c., are subject to variation, so that a few recipes for compounding particular varnishes may be of use.

"*Copal varnish for fine paintings, &c.*—Fuse 8 lbs. of the cleanest pale African gum-copal, and when completely run fluid, pour in 2 gallons of hot oil: let it boil until it strings strongly; and in about 15 minutes, while still very hot, pour in 3 gallons of turpentine obtained from the top of the cistern. There may be much loss of turpentine during the mixing, but the varnish will be so much the brighter, transparent, and fluid, and will work freer, dry quickly, and be very solid and durable when dry. If the varnish be too thick after being strained, hot turpentine is to be added before the varnish is quite cold.

"*Artist's virgin copal.*—From a select parcel of scraped African gum-copal, before it is broken, pick out the very fine transparent pieces, which appear round and pale like drops of crystal; break these very small; dry them in the sun, or by a very gentle fire. When cool, bruise or pound them into a coarse powder. Next, boil some broken bottles or flint glass in soft water and soda, and pound the glass into a coarse powder; boil it again, strain off the water, and wash it in 3 or 4 waters, that it may be perfectly free from grease, dry it before the fire, or in an oven. Mix 2 lbs. of powdered glass with 3 lbs. of powdered copal; put them into the gum-pot and fuse the gum, stirring all the time: the glass will prevent the gum from adhering together, so that a very moderate fire is sufficient to fuse the gum. When the gum is sufficiently run, pour in 3 quarts of very hot clarified oil. Let the varnish boil until it strings freely between the fingers. Mix it rather hotter than if it were body-varnish, for, as there is but a small quantity, it will be sooner cold. Pour in 5 quarts of old turpentine, strain it immediately, and pour it into an open jar or large glass bottle; expose it to the air and light, but keep it from the sun and moisture until it is of sufficient age for use.

"*Cabinet varnish.*—Fuse 7 lbs. of very fine African gum-copal, and, when well run, pour in half a gallon of pale clarified oil: when clear, mix it with 3 gallons of turpentine, and strain. This, if properly boiled, will dry in 10 minutes; but if boiled too strongly, it will not mix with turpentine; and sometimes, when boiled with the turpentine, it will mix, but will not combine with any other varnish that has been less boiled than itself. This varnish is used by japanners, cabinet, and coach painters. Animé is, however, generally used for cabinet varnish.

"*Best body copal varnish*, for the body parts of coaches and other objects intended for polishing, is made by fusing 8 lbs. of fine African gum-copal, and adding 2 gallons of clarified oil. It must be boiled very slowly for 4 or 5 hours until quite stringy, and be mixed off with 3½ gallons of turpentine.

"The foregoing varnishes are made of the finest copal without the addition of driers; they are the palest and best of their kind, and have great fluidity and pliability. They are, however, slow in drying, and it requires months for them to become hard enough to polish well. If the varnish is not required to be very pale, gum of second quality is used, and if required to dry quickly, sugar of lead or white copperas, singly or together, are used in the proportion of ½ lb. to 1 lb. to each of the quantities given in the recipes; but the brilliancy, colour, and durability of varnishes are injured by the introduction of driers. If the varnish be required to dry and harden quickly without the use of driers, animé may be used instead of copal, but it does not form so durable a varnish, and it becomes darker by age. Animé varnish may be mixed with copal varnish in certain proportions, while both are hot. A moderately quick-drying body varnish may be used by mixing 1 part of animé with 2 parts of copal; for an inferior varnish, drying more quickly, 2 parts of animé to 1 part of copal may be mixed.

"*Carriage varnish* for the wheels and under framework of coaches and other objects not requiring to be polished is made like common body varnish, only that to 8 lbs. of gum of second quality are used about 2½ gallons of oil and 5½ gallons of turpentine, with driers. This varnish is boiled until it becomes very stringy. Its quality is intermediate between body varnish and

"*Wainscot varnish*, which is made of 8 lbs. of animé of second quality, 3 gals. of clarified oil, ¼ lb. of litharge, ¼ lb. of sugar of lead, ¼ lb. of copperas. These ingredients must be well boiled until the varnish strings very strong, and it must be mixed with 5½ gals. of turpentine. This varnish, which dries quickly, is used chiefly for house painting and japanning. It may be darkened by the addition of a small quantity of gold-size.

"*Spirit and turpentine* varnishes are prepared by mixing the resins and the solvent together, and agitating the whole with a stick with a number of pegs or nails driven in near the lower end until the solution is complete. The resins should be dry, and in small pieces, with the impurities picked out: the finest and clearest pieces of the gum are set aside for superior varnishes. Turpentine varnishes are made in quantities of 10 or 12 gallons: spirit varnishes from 4 to 8 gallons. In making the latter, the ingredients are sometimes put into a cask of 8 or 16 gallons' capacity, and mounted so as to revolve upon bearings at the ends. An alternating motion is given to the barrel by passing round it a cord terminating in a cross handle. When the operator pulls this cord towards him the barrel rotates, and winds the cord up in the other direction so as to be ready for a second pull, which, in like manner, winds the cord in the opposite direction, and so on. Agitation must be kept up, or the resin will agglutinate. After 3 or 4 hours, or when the solution is complete, the varnish is left for a few hours to deposit solid impurities, and is then strained through muslin or lawn into bottles. Coarsely pounded glass is sometimes added to prevent the agglutination of the resin. When heat is employed in making spirit varnishes, the source of heat should be a water or a sand bath, and a still and worm may be used to prevent loss by evaporation, the resins and solvent in the still being kept in motion by a stirrer passing through a stuffing-box in the head. Shell-lac contains a little wax, which is apt to get diffused through the varnish when heat is applied. The inflammable nature of the ingredients will, of course, suggest the necessity for caution in making spirit varnishes. The utensils employed must be quite clean and dry.

"*Best white hard spirit varnish*, such as will bear polishing, is made by adding 2 lbs. of the best picked gum-sandarach to 1 gallon of spirits of wine, and agitating for 4 hours, until the solution is complete. 18 oz. of Venice-turpentine (or 9 oz. if the work is not to be polished) are to be moderately heated in a water-bath until quite fluid, and added to the varnish to give it body. Agitate for an hour, strain and put into bottles, which must be kept well corked. After remaining undisturbed for a week, the varnish is fit for use. If the clearest and palest pieces of gum be selected, this varnish will be pale enough for white work.

"*White hard varnish.*—(No. 1.) Put 3½ lbs. of gum-sandarach into 1 gal. of spirits of wine, and when the solution is complete add 1 pint of pale turpentine varnish, and shake the whole well together. (No. 2.) 2 lbs. of gum-sandarach, 1 lb. of gum-mastic, and 1 gallon of spirits of wine. *White spirit varnish for violins.*—2 lbs. of mastic to 1 gallon of spirits of wine and 1 pint of turpentine varnish.

"*Brown hard spirit varnish* is similar to white hard varnish, only shell-lac is used instead of sandarach. Dissolve 2 lbs. of shell-lac in 1 gallon of spirits of wine, and then add 18 oz. of Venice-turpentine, warmed. This varnish will bear polishing. Or 2 lbs. of shell-lac, 1 lb. of sandarach, and 2 oz. of mastic dissolved in 1 gallon of spirits of wine. A lighter colour is produced with 2 lbs. of sandarach, 1 lb. of shell-lac, and 1 gallon of spirit. When the solution is complete add a pint of turpentine varnish, and agitate the whole well together. If a pale lac varnish be required, *white* or *bleached lac* may be used. Lac varnish may be bleached by Mr. Leming's process:—'Dissolve 5 oz. of shell-lac in a quart of rectified spirits of wine; boil for a few minutes with 10 oz. of well-burnt and recently heated animal charcoal, when a small quantity of the solution should be drawn off and filtered; if not colourless, a little more charcoal must be added. When all colour is removed, press the liquor through silk, as linen absorbs more varnish, and afterwards filter it through fine blotting-paper.' ('Transactions of the Society of Arts,' vol. xlv.) In the same volume is a recipe by Mr. G. Field for bleaching lac varnish by means of chlorine. Dr. Hare has also published a method as follows:—'Dissolve in an iron kettle 1 part of pearlash in about 8 parts of water, add one part of shell or seed-lac, and heat the whole to ebullition. When the lac is dissolved cool the solution and impregnate it with chlorine gas till the lac is all precipitated. The precipitate is white, but the colour deepens by washing and consolidation; dissolved in alcohol, lac bleached by this process yields a varnish which is as free from colour as any copal varnish.' The application of the chlorine must be made by a person acquainted with chemistry. Hence chloride of lime is safer as a bleaching agent, the lime being afterwards dissolved out from the precipitate by the addition of muriatic acid. The precipitate is to be washed several times, dried, and dissolved in alcohol with the addition of a little mastic. This varnish is very pale, but rather thin.

"When copal is added to spirit varnishes in order to increase their toughness and durability (although the advantage of adding copal may be questioned), the copal should be in fine powder, the spirit very strong, and a gentle heat of about 120°, with frequent agitation, should be used. A light-coloured varnish may be made with ¾ lb. of shell-lac, ¾ lb. of copal, to 1 gallon of strong spirit.

"*Mastic varnish* for paintings is generally made by adding 3 lbs. of mastic to 1 gallon of turpentine. The mastic should be carefully picked and dissolved without heat. After straining, the varnish should be kept in a bottle, loosely corked, and exposed to the sun and air for a few weeks. A deposit takes place, and the clear varnish may be poured off, but it improves by age. Mastic varnish is liable to *chill* from the presence of moisture; but this may be carried down by adding ½ pint of well-washed hot sand to each gallon of varnish, agitating for five minutes, and allowing to settle.

"*Turpentine varnish.*—Dissolve 4 lbs. of common resin in 1 gallon of oil of turpentine at a gentle heat in the sand-bath. The usual plan, however, is to dissolve the resin in the gum-pot. For a pale varnish, bleached resin may be used at a very moderate heat. Turpentine varnish is used for indoor painted works, and common painted furniture and toys. It also adds to the body, hardness, and lustre of other varnishes.

"*Crystal varnish* for maps, prints, coloured drawings, &c.—Dissolve 2 lbs. of mastic, 2 lbs. of damar, without heat, in one gallon of turpentine; or mix Canada balsam and oil of turpentine in equal parts. Warm the balsam until quite fluid and add the turpentine, agitating for a few minutes; then leave the varnish in a moderately warm place for a few hours, and it will be ready for use the next day. A coat of thin crystal varnish applied to one or both sides of good tissue or foreign post paper furnishes *tracing-paper* of medium quality.

"*Paper varnish* for paper hangings, &c.—4 lbs. of damar to 1 gallon of turpentine. White or bleached resin may also be used, alone, or mixed with the damar.

"*Water varnish.*—Lac is soluble in a hot alkaline solution, and furnishes a varnish that will bear washing. The alkali deepens the colour of the varnish, but ammonia does so less than borax, potash, or soda. 16 oz. of liquor ammoniæ to 7 pints of water, with 2 lbs. of pale shell-lac and 4 oz. of gum arabic, give a pale water varnish. Borax is, however, commonly used in the proportion of 2 lbs. of shell-lac, 6 oz. of borax, 4 oz. gum arabic, and 1 gallon of water. White lac is used for the palest water varnishes.

"*Sealing-wax varnish* for coating apparatus, &c.—Dissolve 2½ lbs. of red sealing-wax and 1½ lb. of shell-lac in 1 gallon of spirits of wine.

"*Black varnish.*—3 lbs. of black sealing-wax and 1 lb. of shell-lac to 1 gallon of spirit: or mix fine lamp-black with brown hard varnish or lacquer. Such a varnish is used for blackening the interior of telescope tubes, the lamp-black serving to deaden the bright colour of the lacquer. A black varnish for metal works may be made by fusing 3 lbs. of asphaltum, and ½ lb. of shell-lac, and adding 1 gallon of turpentine. For further details see Mr. Cooley's 'Cyclopædia of Practical Receipts,' where 64 varnish recipes are given. The following remarks on the making of copal varnishes we quote from Mr. Neil. 'The more minutely the gum is run or fused, the greater the quantity and the stronger the produce. The more regular and longer the boiling of the oil and gum together is continued, the more fluid or free the varnish will extend on whatever it is applied. When the mixture of oil and gum is too suddenly brought to string by too strong a heat, the varnish requires more than its just proportion of turpentine to thin it, whereby its oily and gummy quality is reduced, which renders it less durable; neither will it flow so well in laying on. The greater proportion of oil there is used in varnishes, the less they are liable to crack, because the tougher and softer they are. Increase the proportion of gum in varnishes, the thicker the stratum, and the firmer they will set solid and dry quick. When varnishes are quite new made, and must be sent out for

use before they are of sufficient age, they must always be left thicker than if they were to be kept the proper age.'

"Varnishes are applied to flat surfaces with soft clean brushes, and for spirit varnishes camel's-hair pencils and brushes are used. The varnish should be applied in very thin coats, sufficient time being left between two coats for the solvent to evaporate. Spirit varnishes require 2 or 3 hours between every two coats, turpentine varnishes 6 or 8 hours, and oil varnishes 24 hours; but the state of the atmosphere will require these intervals to be varied. The second coat should never be added until the first is quite hard. Care must be taken not to allow dust or loose hairs from the brush to get attached to the varnish; if hairs, &c. do get on, they must be carefully picked out with the point of a knife before the varnish dries, and the surface of the varnish be levelled with fine glass-paper before the next coat is put on. A dry, moderately warm atmosphere (such as that indicated by a temperature of 72°) is required for varnishing, and especially for spirit-varnishing, where the presence of moisture causes a slight precipitation of the resin, producing the effect that is called *chilling* as already noticed; whereas if the air be kept quite dry during the evaporation of the spirit, the resin is left on the surface as a thin glassy coat, which is no longer influenced by moisture, but acts as a perfect transparent protection to the surface to which it has been applied. Cold draughts will also produce the effect of chilling. When the varnish has been chilled, it may often be restored to its required lustre by applying a thin coat of varnish and placing the object at such a distance from the fire as partially to dissolve the chilled coat. Care must, however, be taken not to raise blisters. The articles to be varnished should be smoothed with fine glass-paper, and minute holes in the wood should be stopped with gum or wax. The varnish is usually contained in an ordinary preserve jar, with a wire or string drawn across the top for drawing the brush against so as to reduce the quantity taken up. Enough varnish should be kept in the jar to cover the hairs of the brush; should the varnish become too thick by evaporation it may be thinned down by the addition of spirits of wine, and in general a better effect is produced by the application of a number of thin coats than of a few thick ones. Spirit varnishes should be put on rapidly, and be well worked in so as to exclude minute air-bubbles. Some skill is required to produce a uniform effect, especially in large surfaces. The first coat of varnish is generally absorbed more or less by wood and porous surfaces, and the absorption raises the grain of the wood, so that a second and even a third coat may be required to fill up the pores uniformly. The work is then smoothed with fine glass-paper, and 2 or 3 coats of varnish are afterwards applied. As the absorption of the first layers produces a great expenditure of varnish, it is sometimes used to substitute for the first layers size made of pale glue or parchment cuttings, or solutions of isinglass or tragacanth. Turpentine and oil varnishes are applied generally in the same manner as spirit varnishes, but as they dry more slowly it is easier to produce a uniform effect on large surfaces with them than with spirit varnishes. Coloured works receive their coat of colour before being varnished.

"The finest kinds of varnish work, such as the wooded works of harps, is thus performed:—'The wood is covered with about 6 layers of the white hard varnish, and allowed thoroughly to dry between each; this entirely fills up the pores of the wood: the face is then rubbed quite smooth with fine glass paper. The ornamental painting is then done, after which about 8 or 10 coats of varnish are laid on, and at every third coat the surface is rubbed with fine glass-paper to remove the brush marks. When all the varnish is put on and has become hard, the surface is rubbed with fine pumice-stone powder and water on woollen rags; the work is allowed to stand for a day or two, and is then polished with yellow tripoli and water, after which it is washed quite clean with a sponge and wiped dry with a clean wash-leather. The varnish is now touched at a few places with the finger smeared with fine rendered tallow, which is then thoroughly rubbed all over with the ends of the fingers; clean wheat flour is dusted over the work, and also well rubbed in with the fingers; and after the removal of the flour, the surface is slightly rubbed with a clean old silk handkerchief, which completes the splendid lustre given to these instruments."

In consequence of the enormous consumption of varnishes of all kinds in Birmingham, Wolverhampton, and other places in that quarter, the district has become the principal seat of the varnish and colour trade.

No. 4.—PAINTING AND DECORATION, HARMONY OF COLOURS, ETC.



THE beauty of many of the woods which are used by the joiner and cabinet-maker make it a matter of regret that all house-fittings cannot be made of oak, cedar, maple, satin, or other beautifully grained woods; but economy is imperative, and the man of moderate means can no more revel in these than in other luxuries. In France and other countries, however, the use of oak for flooring is a great economy, for a large expense is saved in carpets, and, moreover, the oak is far better and cooler than carpets, while it affords scarcely any shelter for noxious insects. The floors of ordinary houses in our own country certainly have a mean appearance when uncovered, but the habit of staining the deal flooring has been adopted to some extent, and is to be recommended as cleanly, effective as regards tone, and not expensive. Undoubtedly, natural wood is pleasant to the eye, and, if that be found too costly, stained natural wood is certainly preferable to painted. But even ordinary deal may be made very presentable by varnish, and in churches and other public buildings, and in some houses, the doors, window-frames, and other woodwork are simply covered with a coat or two of varnish, and look well. All that is necessary is that the builder should set aside all the planks showing grain, and free from knots and other faults, for his doors and other visible woodwork, and when the house is finished have them carefully varnished. This system has been applied to furniture, and nothing can be more pleasing in appearance than suites of pine-wood furniture for the bedroom, which have sold to a considerable extent. Cottage pianos and other articles have also been fitted in the same manner to a smaller extent; but still ninety-nine houses out of a hundred depend upon painting to a large extent for their finish, and the subject is therefore an important one.

Paint is a kind of paste, made by grinding white-lead and linseed-oil. Other substances are used, such as colouring matters or *stainers*, as they are called, drying materials or *driers*, &c.; but white-lead is the basis of all ordinary paints, and forms at least nine-tenths of their composition. The laborious and unwholesome operation of grinding paints with a grinding-stone and muller, which was formerly done by the painter, is now performed by the manufacturing chemist on a large scale in mills. The linseed-oil is sometimes boiled, which gives it a greater facility in drying, but makes it thick, so that it is only fit for outdoor work. Spirits of turpentine, called *turps*, are also much used. Litharge and sugar of lead, ground in oil into a thick paste, are used as driers. Japanner's gold-size is used for the same purpose. Ochre, Venetian-red, lamp-black, Indian-red, Turkey and English umber, terra de Sienna, red-lead, Prussian-blue, orange-red, chrome-yellow, vermilion, and other pigments are used as stainers.

Surfaces are prepared for painting by means of sand-paper or pumice-stone, and by filling up with putty, for the purpose of getting rid of inequalities. Heads of nails are punched in and stopped. Knots in the wood, which would bulge out, or leave a stain, are removed or cut out to the depth of ½ inch, and pieces of the same wood inserted in their places, glued in hand-tight only, for if compressed with a hammer they may afterwards swell and spoil the surface. For ordinary work knots are merely painted over with red-lead and size.

In order to paint plaster, such as the walls of a room or hall, properly, five coats are required. If the plaster be not very absorbent four will suffice. The first consists of white-lead diluted with linseed-oil to a thin consistency, with the addition of a small quantity of litharge to insure the drying. If the plaster be *quick* the oil is entirely absorbed, thereby hardening the plaster to the depth of ⅛ inch. The second coat is also thin, in order that the plaster may be thoroughly saturated. This coat is only partially absorbed. The third coat is thicker, and contains a little turps, and some of the colouring pigment, so as to bring it near the tint required. The fourth coat is as thick as it can be used, equal parts of oil and turps being employed. The colour is used several shades darker than the finishing coat, and the drier is sugar of lead. The coats must be laid on carefully and smoothly, each being rubbed lightly with sand-paper before the next is applied. The finishing or *flatting* coat, as it is termed, from its drying without gloss, is of pure white-lead diluted with spirits of turpentine only, and is made a few shades lighter than the pattern, since it darkens in drying. A small portion of japanner's gold-size is used as the drier. The coat is applied as quickly as possible, since the turps evaporates in little more than a minute after being applied, leaving an even flatted surface. The time which is to be allowed between the application of the several coats will depend on the weather, the quantity of drier employed, and the state of the internal atmosphere. A few days should elapse between the putting on of the first two coats; a somewhat longer time before the third is put on. The last coat before the flatting should not be left more than two days, since much of the beauty and solidity of the work depends on the latter drying into and uniting with the former.

The absorption of moisture by the plaster of ceilings may be prevented by applying two coats of paint, and when dry and hard a coat of *distemper* colour—that is, white-lead ground in water and diluted with size made from parings of white leather and parchment. But in distemper painting it is very common to substitute whiting for white-lead.

The painting of wood is similar to that of plaster, each coat being thicker and smoother than the previous one. In imitations of oak, marble, &c., there is a groundwork of four or five coats, care being taken that no brush-marks be left. The last coat, instead of being flatted, is composed of equal parts of oil and turps. The shades and grain of the wood are given by thin glazings of Vandyke-brown, terra de Sienna, or umber, according to the kind of wood to be imitated. The colours are ground in water and mixed with small beer, the tenacity of which is sufficient to prevent its rubbing off by the application of the varnish which immediately follows.

The imitation of the grain of the wood is produced by means of combs made of horn, ivory, &c., and with teeth of different degrees of fineness, with which the glaze is scored in straight lines, waves, and curls, varied by skilful turns of the operator's wrist, and afterwards softened off by means of special brushes made for the purpose. It must be admitted that common graining is often very slovenly work, executed by rule of thumb and with little or no skill; but some kinds of wood, as for instance pollard oak and walnut, and bird's-eye-maple, are often executed by able grainers in such a way as almost to deceive the eye. In the imitation of variously coloured and figured marbles even more cleverness is exhibited, and the best work of this class is very remarkable.

The brushes with which house-painters work are too well known to require notice; but it may be mentioned that they should be held upright, so that the paint may fall from the tip of the brush, or *tool*, as it is called, when small, into the interstices of the wood, and not be left in masses on the surface. Decorative painters and grainers use camel-hair pencils principally. Paint remaining in pots is protected by being covered with water, and so also are brushes; but while the former is preserved uninjured for a long time, the latter are not—they harden and soon become unfit for use; they should be cleaned thoroughly with oil when laid by.

On this subject Professor Archer says:—

"The artist lays all the kingdoms of nature under contribution to supply his numerous wants, and it is questionable if he could dispense with either of them. Certainly he could not do without the Animal. There are few branches of high Art or decorative Art in which brushes of some sorts are not required, and these are nearly all derived from the animal kingdom. First of all we have the familiar Camel-hair Pencil with which we make our first infantile essays in daubing. This is one of the most important tools of many artists; its name is admirably chosen, for it is strictly the hair of the camel in contradistinction to the finer material or fur with which the animal is much more abundantly covered. This stately creature, 'the ship of the desert,' notwithstanding its exposure to intense heat in the almost burning deserts of Africa, has really a thick coating of fur which, like the turban of its master, acts rather as a cooler than otherwise; for if its non-conducting properties prevent the animal heat from escaping, those same properties keep off the much greater heat of the sun. But thickly sprinkled, for some wise purpose, through this close mat of fine fur are a large number of long silky hairs. These are the treasures of the brush-maker, and are carefully picked out, and arranged with the points all one way, ready to be made up in brushes, or pencils, as they are generally called. This same pencil-making is a very nice art, and may be brought to a great perfection, not always apparent on a cursory examination, but which is fully appreciated when submitted to the test of use. The camel-hair comes to us from Mogadore, and from Egypt and Turkey, usually picked out from the fur, but not always. There are three qualities in our commerce: the finest, which is nearly black in colour, the second reddish, and the third grey.

"Most of the so-called fur animals, like the camel just mentioned, have the two kinds of covering—the one fine, soft, and close, being the *fur* proper; the other longer, stiffer, and more sparingly distributed over the skin. These long hairs are obtained from several, such as the Fitchet, the Sable, the Marten, and others of the same family (*Mustelidæ*). The process of removing these hairs was formerly tedious and difficult, but an ingenious invention, patented by Mr. Roberts, the eminent furrier, of Regent Street, has simplified it much. Mr. Roberts, seeing the well-known fact that the long hairs all penetrate deeper into the skin than the fur, invented a plan of paring off a thin layer of the under part of the skin, by which mean the long hairs are rendered loose, their lower extremities being thus cut through, and they are then easily shaken out without injuring the fur. Pencils made of these hairs require even greater care than those made of camel-hair; their points must be arranged with the nicest exactness, in order to insure, when brought together, a beautiful gradation to one central point—a task only accomplished by very skilful hands after much practice.

"Of the larger kinds of brushes or 'tools' used by artists, those made of hog's bristles are the most important; indeed they may be said to be the staple articles of this kind. Almost every size is used, from the house-painter's brush to cover large surfaces, down to the fine pencil for minute touches. The best bristles come from Russia, where they form a very important article of trade. From the Baltic provinces we receive the bristles, well packed in casks, but tied up in little bundles. The same comparative care is required to insure goodness in the artist's bristle 'tools' as in his finest 'hair pencils,' and every bristle is carefully sorted for the purpose. To sort out a pound of bristles is a task which few would like to undertake, but it is now made very easy and simple by one of the ingenious contrivances which the present age of inventions has brought forth. The bristle-sorting machine of Mr. W. S. Yates rapidly separates a handful of mixed bristles into fourteen different lengths, so as to be available at once for the manufacture of a variety of brushes.

"The hair of the badger is very important in the manufacture of artists' brushes; but it is scarce, and has to be brought from abroad. Goat-hair is also used for pencils, but not very extensively: goat-hair pencils are, however, favourites with some oil-painters."

A short time and a little instruction will make any one, who will give his attention to it, a good plain painter; but the production of good graining, imitation woods and marbles, requires some study and much patience and perseverance. For the benefit of those who have not the opportunity of obtaining instruction in painting and graining, or of apprentices or young workmen who desire to gain all the information they can, we may mention that report speaks well of a work entitled "A Manual of House Painting, Graining, &c.," by Mr. Ellis A. Davidson, but we cannot speak from personal experience of it. It deals with the whole subject of plain and imitative painting, and gives coloured illustrations of graining and marbling.

Proceeding from plain to decorative painting, we come to the highly interesting subject of the harmony of colour—the foundation of successful treatment of everything into which colour enters as an element, whether in the form of pigment or dye. The rules of this harmony of colours are derived from the investigation of the phenomena of light, through the intervention of the prism, and those who would thoroughly understand such rules must study the works of men of science who have given great attention to it. The most famous of these works was published in Paris in 1839 by M. Chevreul, now the oldest member of the Académie des Sciences of France. It treats of the law of contrasts of colours, and the arrangement of coloured objects, in relation to painting, the tapestry of the Gobelins and of Beauvais, of carpets, mosaics, stained glass, printed fabrics, printing, illumination, decoration, horticulture, and dress. It is unnecessary to say that it is a large and expensive work. Its contents have, however, entered into our scientific literature; much of it will be found in the chemical reports and memoirs, by the late Professor Graham, published by the Cavendish Society, and the general facts and deductions in all good scientific dictionaries and manuals. The introduction to the study of "Natural Philosophy," published by Mr. Weale, will supply the student with the principles of optics and optical instruments.

Our remarks will be limited to those facts and deductions which apply strictly to practice.

The assortment and arrangement of colours in the arts and manufactures is a subject which, notwithstanding its acknowledged importance, has received but little attention in this country. Persons who have a natural taste, an *eye for colour* as it is called, are able so to group and arrange the colours, patterns, and goods at their disposal as to produce pleasing and harmonious effects; while others who are not so gifted produce by their arrangements a discord to the eye of the colourist, which is analogous to the effect produced on the musical ear by instruments out of tune. The study of the various phenomena of colour is a delicate and in some respects a difficult one; but from the time of Newton's capital discovery of the compound nature of light the subject has engaged the attention of scientific men. Among those who have laboured in this important field with success, M. Chevreul is eminent; and we propose to give a very brief sketch of that part of his inquiry which relates to the influence which two colours may exercise upon each other when seen simultaneously.

It has been already shown that a ray of white light can be decomposed or resolved into seven coloured rays—viz. *red, orange, yellow, green, blue, indigo*, and *violet*: that of these seven colours, the *red*, the *yellow*, and the *blue* are *simple* or *primitive* colours, capable by their combination of forming *white* light; the other four coloured rays being formed by combinations of two of the primary colours: thus the combination of *yellow* and *red* produces *orange*; of *yellow* and *blue*, *green*; while *red* and *blue* produce *violet*. The rays comprised in the same group, the *red* rays for example, are not identical in colour; they differ more or less among themselves, although the sensation produced by each one is known by the term *red*.

When light is reflected by an opaque white body, the differently coloured rays are reflected in the proportion to constitute white light; but if light fall upon a body which entirely absorbs it, as in penetrating a perfectly dark hole, such body appears black, and cannot be seen unless it be situated near other bodies which reflect light to it. When light falls upon a coloured body which does not entirely absorb it, there is always some reflection of white light, and of light of the same tint as that of the absorbing body: if the rays absorbed by the coloured body be united to the coloured reflected rays, they will form white light. These reflected rays are said to be *accidental* or *complementary* to the absorbed rays, and differ with the colour of the body on which the rays fall.

If the *blue* and *yellow* rays be absorbed, then the reflected *red* ray is the accidental or complementary colour.

If *blue* and *red* be absorbed, *yellow* will be reflected.

If *yellow* and *red* be absorbed, *blue* will be reflected.

If *red* be absorbed, *green* will be the complementary colour reflected.

If *yellow* be absorbed, *violet* will be reflected.

If, therefore, we wish to produce white light from any coloured ray or rays, we must add thereto the complementary ray.

Complementary colours may be seen by fixing the eye steadily upon a coloured object, such as a wafer upon a sheet of white paper; a ring of coloured light will play around the wafer, and this ring will be complementary to the colour of the wafer; a *red* wafer will give a *green* ring; a *blue* wafer an *orange*-coloured ring, and so on. Or if, after having regarded the coloured wafer steadily for a few seconds, the eye be closed or turned away, it will retain the impression of the wafer, not in its own but in its complementary colour. Thus a *red* wafer will give a *green* spectrum, &c.

It is on the principle of complementary colours, that two colours or two different shades of the same colour placed in juxtaposition heighten each other's effects. For example, take two bands O and O′ of the same colour and identical, and two other bands P and P′ of another colour and identical;

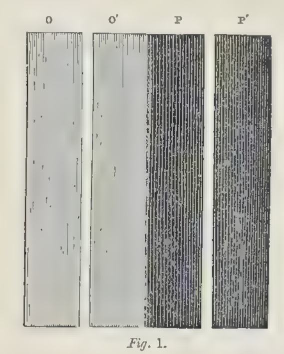


Fig. 1.

they must be ½ inch wide, and 2½ inches long, and they may be formed of stuff, paper, ribbon, &c. The band O′ is to be gummed to a card with O at the distance of $\frac{1}{20}$th of an inch from it; the band P is to be placed so as to touch O, and lastly P′ is to be gummed on at the distance of $\frac{1}{20}$th of an inch from P. Now, if we look at the card in a certain direction, and during some seconds, we shall generally see *four differently* coloured bands. It will be observed that O′ and P′ serve as terms of comparison to judge of the modifications experienced by O and P in their juxtaposition.

In the following seventeen observations, the colours named in the left-hand column were arranged as above; the colours named in the right-hand column show the modifications which they experienced by juxtaposition. Thus, in the first example, the *red* was modified into a colour inclining to *violet*, and the *orange* was modified into *yellow*.

Colours used in the experiment.	*Modification.*
1. Red	inclining to violet.
Orange	,, yellow.
2. Red	,, violet, or less yellow.
Yellow	,, green, or less red.

Colours used in the experiment.	*Modification.*
3. Red	inclining to yellow.
Blue	„ green.
4. Red	„ yellow.
Indigo	„ blue.
5. Red	„ yellow.
Violet	„ indigo.
6. Orange	„ red.
Yellow	„ bright green, or less red.
7. Orange	„ red.
Green	„ blue.
8. Orange	„ yellow, or less brown.
Indigo	„ blue, or brighter indigo.
9. Orange	„ yellow, or less brown.
Violet	„ indigo.
10. Yellow	„ brilliant orange.
Green	„ blue.
11. Yellow	„ orange.
Blue	„ indigo.
12. Green	„ yellow.
Blue	„ indigo.
13. Green	„ yellow.
Indigo	„ violet.
14. Green	„ yellow.
Violet	„ red.
15. Blue	„ green.
Indigo	„ deep violet.
16. Blue	„ green.
Violet	„ red.
17. Indigo	„ blue.
Violet	„ red.

The reciprocal modifications of colour are not limited to the case where the modifying coloured zones are contiguous to one another, for they may be observed even when the zones are separated. For example, take two strips of the *blue* paper, and two strips of the same *green* paper, the blue and green being of the same height of tone. Let the strips be 4 inches in length, and ¾ of an inch wide. Place them parallel to one another, so that the two central strips of blue and green are nearly ½ of an inch apart, and the two outer strips of blue and green each ½ of an inch from the two inner ones. Then, standing at a distance of six paces from the card, the colours will appear modified; the central blue will be of a less green blue than the outer blue; and the central green will be of a green more yellow than the outer green.

All the foregoing phenomena are expressed by M. Chevreul in the following simple law:—"When the eye sees at the same time two colours which are in contact, they will appear as dissimilar as possible." Hence the colour of the strip O, Fig. 1, will differ as much as possible from that of the stripe P when the complementary colour of P is added to the colour of O: in like manner the colour of P will differ in the greatest possible degree from the colour of O, when the complementary colour of the latter is added to the colour of P. Consequently, in order to know what the two colours O and P will be when in juxtaposition, it will be sufficient to find the complementary colour of P, and add it to the colour O, and the complementary colour of O, and add it to P. For example, take any one of the above seventeen cases, such as the *green* and *yellow* strips, the result will be as follows: *red*, the complementary colour to *green*, on being added to *yellow* makes it incline to *orange;* and *indigo* inclining to *violet*, the complementary colour to *yellow*, makes *green* incline to *blue*. So also with *red* and *blue* strips: *green*, the complementary colour to *red*, on being added to *blue* makes it incline towards *green;* and *orange*, the complementary colour to *blue*, on being added to *red* makes it incline towards *orange*.

It will be evident that, other things being the same, the modification of the juxtaposed colours will be more marked in proportion to the difference between the complementary colours added to each: for supposing that the complementary colour added to O, Fig. 1, be identical with it, and that the complementary colour added to P were identical with it also, the modifications of O and P would be confined to a mere augmentation in the intensity of the colour. But we are not acquainted with two perfectly pure colours complementary to each other. All reflected rays of colour transmit not only white light, but also variously coloured rays. It is therefore impossible to name a *red* body and a *green* body, or an *orange* body and a *blue* body, or a body of a *yellow* inclining to *orange* and an *indigo*-coloured body, or, lastly, a body of a *yellow* inclining to *green* and a *violet*-coloured body, reflecting colours that are perfectly pure and complementary to each other, so that their juxtaposition shall merely occasion a simple augmentation of intensity in colour. If therefore it be less easy in general to verify the law of contrast with respect to *red* and *green* bodies, or *orange*-coloured and *blue* bodies, &c., than with respect to those treated in the seventeen observations already detailed, it will be found that in endeavouring to establish this law for the first-named bodies their colours will acquire a most remarkable splendour, vivacity, and purity; because, by the law already stated, any object, say of an *orange* colour, reflects *blue* rays just as an object of a *blue* colour reflects *orange* rays. So that when we place a *blue* strip in contact with one of an *orange* colour, the colours of the two objects in juxtaposition will be mutually purified and rendered more brilliant, whether this arise from the first-named strip imbibing *blue* from the vicinity of the second, as that again receives *orange* from the vicinity of the *blue* strip; or whether we assume that the *blue* strip destroys the effect of the blue rays of the second strip, as that destroys the effect of the *orange* rays from the *blue* strip. It may, however, happen that the *blue* appears to incline to *green* or *violet*, and the *orange* to *yellow* or *red;* that is to say, that the modification is not limited to intensity of colour, but extends likewise to the physical composition. If the latter effect be produced, it will be much more feeble than the former; and in looking a certain number of times at the same coloured strips, the *blue*, which at first appeared more *green*, will soon appear more *violet;* and the *orange*, which at first seemed to be more *yellow*, will soon appear to be more *red*, so that the phenomenon of modification, which depends upon the physical composition of the colour, will not be so constant as those treated of in the seventeen observations.

White is also affected by the presence of colours. If a *coloured* strip be placed by the side of a *white* one, the latter will appear slightly coloured by the complementary colour of the coloured strip. Thus, with a *red* and a *white* strip, *green*, the complementary colour to *red*, blends with the *white*, and the *red* appears to be deeper and more brilliant.

Black and *white*, which may to a certain extent be considered complementary to each other, become, conformably to the law, more different from each other than when seen separately, owing to the effect of the white light reflected by the black, being more or less destroyed by the light of the white band. By an analogous action, *white* heightens the tone of the colours with which it is brought in juxtaposition.

The phenomena presented by *black*, when exposed to the influence of colours, seem to be owing to the colour with which it is brought in contact acting relatively to the eye, upon the *white* light reflected by the *black* surface, in the same manner as if it were brought in juxtaposition with a *white* surface. Hence the *black* should be tinged with the complementary tone of the colour touching it; and as the tinge which it assumes is not weakened by so much *white* light, as in the case where the colour is brought in contact with white, it must be so much the more striking. On the other hand, as *white* heightens the tone of colours brought in contact with it, *black*, on the contrary, tends to make them *lighter*. The tone of black must depend: 1. Upon the colour added to it; for example, an *orange-coloured red*, an *orange-coloured yellow*, or a *yellowish green* will brighten it; while *indigo*, even if it does not heighten the tone, will not reduce it. 2. Upon the force or brilliancy of the colour in juxtaposition with it; thus bright colours, as *orange* and *yellow*, tend by their brilliancy to add force to *black;* while *sombre* colours, such as *blue* and *indigo*, do not produce a similar effect.

When *red* and *black* strips are made the subject of experiment, *green*, the complementary colour to *red*, blends with *black*, and makes it appear less *reddish*, the *red* becomes more brilliant, and has less of an *orange* or *brown* tone of colour. With *green* and *black* strips, *red*, the complementary colour to *green*, blends with *black*, rendering it more *violet* or *reddish*. With *indigo* and *black*, the *yellow inclining to orange*, the complementary colour to *indigo*, blends with *black*, and brightens it considerably; the *indigo* also becomes brighter.

When a great difference is produced by the juxtaposition of two colours, it is rendered appreciable by bringing the same colour successively in contact with the various colours belonging to one group; for example, *red* and *orange:* on placing a *scarlet* or a *crimson red* in contact with an *orange*, the *red* will acquire a *purple*, and the *orange* a *yellow* tone of colour. *Red* and *violet:* analogous results are obtained in bringing a *scarlet* and *crimson red* in contact with *violet;* the latter will appear to be *bluer*, and the *red* more *yellow* or less *purple*.

The juxtaposition of coloured strips shows how difficult it is to fix the *type* of colours. For example: 1. On placing *red* in contact with an *orange-coloured red*, the former appears *purple*, and the latter more *yellow;* but on placing the first-named *red* in contact with a *purple red*, the latter becomes more *blue*, and the former more *yellow* or *orange*, so that the same *red* will be *purple* in one case, and *orange* in the other. 2. On placing *yellow* by the side of an *orange-coloured yellow*, the former appears *greenish*, and the latter more *red;* but on bringing the first-named *yellow* in contact with a *greenish yellow*, the latter will appear *greener*, and the former more *orange*, so that the same colour will in one case incline to *green*, and in another to *orange*. 3. Place *blue* in contact with *greenish blue:* the former will incline to *violet*, and the latter will appear more *yellow*. If the same *blue* be brought in contact with a *violet blue*, the former will incline to *green*, and the latter will appear more *red:* so that the same *blue* will have a *violet* tinge in one case, and a *greenish* hue in the other. Hence it appears that the simple or primitive colours, *red*, *yellow*, and *blue*, insensibly pass by the effect of juxtaposition into the condition of compound colours, the same *red* becoming *purple* or *orange*, the same *yellow*, *orange*, or *green*, and the same *blue*, *green*, or *violet*.

M. Chevreul applies the term *simultaneous contrast* to the modification of colour and height of tone experienced by two differently coloured objects

when seen simultaneously; and the term *successive contrast* to the phenomena observed when the eyes, after having looked for a certain time at a coloured object, perceive images of a colour complementary to that of the object. The physiological explanation of the successive contrast of colours is based upon the following proposition by Scherffer: "That if a double impression, of which one is vivid and strong, and the other weak, be produced upon one of the senses, we shall perceive the stronger of the two. This occurs principally when both are of the same kind, or when the powerful action of an object on one of the senses is followed by another of the same nature, but infinitely weaker or less violent." To illustrate this let us look for some time at a small *white* square placed upon a *black* ground. On ceasing to look at this, and turning the eye upon a *black* ground, we perceive the image of a square, equal in extent to the *white* square, but instead of being *lighter* than the ground, it will be *darker*. The explanation is, that the part of the retina on which the *white* light of the square acted at the first part of the experiment is more fatigued than the remainder of the retina, which has only received a faint impression from the faint rays reflected by the *black* ground: the eye then being fixed upon the *black* ground during the latter part of the experiment, the weak light of this ground acts more strongly upon that part of the retina which is still unexhausted, than upon that which has already been fatigued; and hence arises the image of the *black* square seen by that portion of the eye.

If we look for some time upon a small *blue* square on a *white* ground, and turning the eye away from the square fix it on the *white* ground, we see the image of an *orange* square. The explanation is, that the part of the retina on which the *blue* light of the square has acted in the first case, being more fatigued by this colour than the rest of the retina, it happens in the latter part of the experiment, that the retina which is fatigued by the *blue* is consequently disposed to receive a stronger impression from *orange*, the complementary colour of *blue*.

It appears, then, that in cases of successive contrast accidental colours arise from fatigue of the eye; but M. Chevreul does not admit this to apply to cases of simultaneous contrast; for in arranging the coloured strips, as in Fig. 2, as soon as we succeed in seeing all four together, the colours may be observed to be modified before the least fatigue is experienced by the eye, although it frequently requires several seconds before the modifications can be perfectly recognised. But the time thus employed appears to be as necessary as that which we give to each of our senses, whenever we wish to give an exact account of the perception of a sensation affecting them. Time seems also to be required, on account of the influence of white light, reflected by the surface modified, and which is sometimes strong enough to weaken the result of the modification, and it is only when the influence of this white light begins to decline that the accidental colours of simultaneous contrast are favourably seen. It is further owing to this cause that *grey* and *black* surfaces, contiguous to the surfaces of very bright light colours, as *blue*, *red*, and *yellow*, are modified more than a white surface would be by their vicinity.

M. Chevreul does not pretend to reduce to theory the beautiful and important phenomena which he has so skilfully and industriously brought together from his own labours, and from the labours of others. He wishes to express the general fact, "that when the eye is struck at once by two colours, which it views with some degree of attention, the analogous character of these colours acts less powerfully upon the optic nerve than the heterogeneous; or, in other words, the eye evinces less sensibility in catching the analogies than the differences of the colours, and this without our being able, generally speaking, to say that the organ is fatigued." It is also shown "that two colours seen distinctly and simultaneously are mutually modified, independently of their respective extent, even when they are not in contact, and when there is no ground for attributing their modifications to a fatigue of the eye."

Some objections may perhaps be made to the use of the term *simultaneous*, on the ground that the distinct vision of two separate colours is, in fact, successive; for it is not possible to fix the eye steadily upon two colours at the same instant; and when we fancy we succeed in doing so, the eye is in fact passing rapidly from one to the other; in which case the modifications of colours by juxtaposition is a purely physiological effect, and the theory of Scherffer will apply. The effects on the mind are, however, the same as if the contrasts were really simultaneous; and they are now so well understood that it is quite easy to determine beforehand the exact effect which any given combination of colours will produce. This is one of the valuable results of the inquiry, and it is gratifying to know that if M. Chevreul has not succeeded in framing a satisfactory theory of complementary colours, he has at least established a rule or law of an eminently practical character. We will give a few of its applications.

Suppose a painter to have delineated two stripes in a picture, a *red* stripe and a *blue* stripe in contact; the phenomena of the contrast of two colours in juxtaposition would occur, unless the painter had taken care to sustain the *red* contiguous to the *blue* stripe by *blue*, and the *blue* stripe by placing *red* or *violet* near the *red* stripe. A weaver having to imitate the two stripes, ignorant of the law of the contrast of colours, will select his wools or silks of only one *blue* and one *red*, and thus bring about the phenomena of contrast which the painter avoided by an ingenious artifice. Or if the painter had not blended the colours on their contiguous borders, they would have contrasted. Now if the weaver, ignorant of the law of this phenomenon, and attempting to imitate his model, were to blend *yellow* or *orange* with the *red*, and *yellow* or *green* with the *blue* in the parts of the stripes that came in contact, the contrast would be more or less exaggerated; because the weaver attempted to imitate the effect of homogeneous colours produced by the picture, by working with homogeneous colours.

Let a paper, Fig. 2, divided into 10 equal zones, be first painted with a uniform tone of any colour, as with Indian ink: let the zones 2 to 10

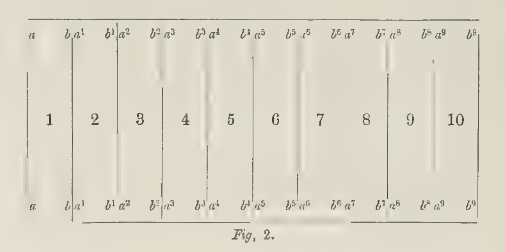


Fig. 2.

receive a second wash of the same uniform tone; let the zones 3 to 10 receive a third, and so on until 10 zones be procured which gradually increase in depth of tone, proceeding from the first onward. The remarkable part of the phenomenon is, that each zone will present at least two shades, owing to the contrast produced by contiguity; for instance, in beginning from the first the border *b b* of this zone, contiguous to the border a^1 a^1 of zone 2, will appear lighter than the border *a a;* and consequently two shades will be presented in zone 1, and the same in the others. But it is possible that a larger number may be distinguished, especially in the intermediate zones between 2 and 9, provided they are of sufficient breadth, and this is owing to the borders a^1 a^1 a^2 a^2 being lighter, and the borders b^1 b^1 b^2 b^2 darker than the general tone of the zone, when, by reason of contrast, the middle of the zones, being less affected than the borders, will present a third tone of colour. It is evident that the three tones, or the two tones as the case may be, presented by the zone, will not terminate abruptly, but blend into one another. Now, if a weaver were to copy this figure, and were not acquainted with the effect of contrast of contiguous zones, he would exaggerate the effect in his work, using probably at least twenty shades of the same colour, instead of the ten.

"I have frequently," says M. Chevreul, "been appealed to as an arbiter in cases where persons have given to be printed various woollen stuffs for furniture, and ladies' cloaks, and have had disputes with the printer on the subject of the patterns, which were not of the colour intended. I have often found that these complaints depended upon the effect of the contrast of the colour of the designs with that of the ground, and that if the printer were reprehensible, it was not for having printed a different colour from the one required, but for not having foreseen the effect that would result from the contrast of colours, one of which was to serve as a ground for another." For example, when *black* patterns are printed upon *red*, *crimson*, or *amaranth* grounds, they appear *green*, the complementary to the ground appearing on the black. For the same reason, *black*, when printed on *violet* stuffs, or on *dark green*, loses all its force. In order to prove that the designs which do not appear black are really black, all that is necessary is to cut a piece of white paper so as to cover the ground, and show only the pattern. Similar difficulties arise in manufactories of paper-hangings, when it is required to produce a design of a slightly *yellowish grey* upon a *green* ground; the designs, although actually grey, appear to be *pink*, owing to the complementary colour of the ground. If printed on *rose*-coloured ground, they appear *green* for the same reason. In printing letters on coloured paper, the ground should always be complementary to the colour of the ink. Thus a *violet*-coloured ink must be used for *yellow* paper, and *yellow* ink on a *violet*-coloured paper; *red* ink on *green* paper, and *green* ink on *red* paper; *orange*-coloured ink on *blue* paper, and *blue* ink on *orange*-coloured paper.

"The upholsterer and house decorator, in the assortment of stuffs with fancy woods for making sofas, easy chairs, &c., must attend to the law of simultaneous contrast. Thus *violet* or *blue* stuffs should be selected for *yellow* woods, such as orange wood, the root of the ash, &c., and *green* or *yellow* stuffs for *red* woods, like mahogany. The colour of the stuff must be as different as possible from that of the wood. A crimson stuff is one of the best wearing colours, and hence it is often used with mahogany. The bad effect of this arrangement may be diminished by placing a broad *green* or *black* border, a cord, or a printed band, between the *crimson* and the *mahogany*. It is not uncommon to border *crimson* with a *gold* cord, or band, fastened on with gold-headed nails; and although these borders

are not complementary, the effect is brilliant. There is one combination which ought never to be made, viz. *yellowish-red* as *scarlet*, *flame*-coloured, or *light red* stuffs, with mahogany: since their brightness deprives the wood of its characteristic red colour, and makes it resemble oak or walnut. Decorative painters fall into the fault of using *pink* or a light *amaranth* for the hangings of boxes in a theatre, the effect of which is to give a *greenish* tinge to the complexion. In the choice of patterns for damasks, for furniture, opposition of the grounds with the predominating colour of the designs upon them is too often disregarded. For instance, where a wreath of flowers is to be represented on a *crimson* ground, the greater part ought to be composed of *blue*, *yellow*, and *white* flowers; if *red* flowers are introduced, they should border on *orange* rather than *purple;* while *green* leaves laid directly on the ground conduce considerably to the beauty of the whole; where the ground is *green* or *dead-leaf*, the predominating flowers ought on the contrary to be *pink* and *red*."

Not only may the pattern designer, whether for figured stuffs, silks, carpets, &c., derive much assistance from the study of these details, but also the artist, the glass-stainer, all those, in short, who have to deal with colour.

Two works by Mr. Benson must not be forgotten—namely, a manual, which forms a small volume, and treats the whole subject of the Science of Colour generally; and a larger volume, which illustrates the harmonies of the natural system: these volumes are given as prizes by the Department of Science and Art.

The harmony of colour is a subject which demands the most careful study on the part of those who would be artists or art-workmen, and we cannot do better service to any earnest student than recommend him to study the works of one of the greatest masters in colour that ever lived, the late Owen Jones; and amongst those works we may specially point out the report of the paper, entitled "An Attempt to define the principles which should regulate the Employment of Colour in the Decorative Arts," read before the Society of Arts on the 28th of April, 1862, and printed in a small volume for the Society with a valuable collection of other papers, one of which we should mention as belonging specially to our subject, that of the late Sir Digby Wyatt, "An Attempt to define the Principles which should determine form in the Decorative Arts."

Unfortunately colours and pigments, although the words are often used indiscriminately, are very distinct things: we see *colours* in the prism, we search in the mineral and vegetable and animal world for substances, *pigments*, which produce as near a resemblance to those colours as possible. In order to give a general idea of the origin of these pigments, we quote the following from an interesting paper by Professor F. C. Archer, Director of the Industrial Museum of Scotland. Speaking of the colours derived from gold, Professor Archer says:—

"The first of these is the well-known 'purple of Cassius,' of such infinite use to the artist in stained glass and porcelain painting. This beautiful metallic colour—which is of the richest purple if used as a pigment on the surface of glass or porcelain, but which, when melted in the glass, gives the well-known ruby red so much admired in the best Bohemian glass—is a compound of the terchloride of gold with the perchloride of tin, which is said to have been discovered by Dr. Andrew Cassius, of Leyden, about 1865; but although he has given his name to the definite compound now known as purple of Cassius, the old alchemists were aware that gold, of certain combinations, gave a ruby colour to glass. Secondly, this same chloride of gold, which in combination with tin produces the gold-purple, is alone used as an important agent in the art of photography,—for art it is, notwithstanding the decision of the Royal Commissioners of the International Exhibition to class it with machinery and similar matters. By its peculiar reducing action upon the salts of silver, this gold compound communicates an agreeable purplish or violet tone to the otherwise deep brown shades of the nitrate of silver. Thus we have seen that the glittering metal, gathered from the rocks and sands of distant countries, besides being made to spread in thin films over decorated surfaces, also tints with rosy hue or rich crimson the cathedral window, and enriches the shades of the sun-pictures of the photographer."

Of copper he says:—

"Chemistry produces upon it changes which convert it into more than one beautiful pigment. These, when the result of natural chemical changes—as in the case of mountain green, or bice, which are different names for the beautiful colour prepared from malachite (native bicarbonate of copper)—are very fine permanent colours. When, however, they are artificially prepared, although little inferior in brilliancy, they are less trustworthy on canvas, and should be employed with great caution. Besides those mentioned, there are Scheele's green, emerald green, Bremen green, Brighton green, Brunswick green, Mitis green, Schweinfurth green, and verditer—all well-known pigments—owing their colour to the copper of which they are chiefly composed. And besides these there is the exquisitely beautiful chrome green of the enamellers, which, although properly a preparation of chromium, is made with the assistance of the ammoniacal salts of copper.

"To lead the artist is indebted for one of the most important of the materials employed in painting—the white-lead, which forms, when properly prepared, not only a white colour, but also a vehicle and diluent for most other colours. This material is made by acting upon thin plates of lead with the fumes of vinegar or acetic acid. The *rationale* of this process is not well understood, but the result is the formation of a beautiful white carbonate of lead, which, when thoroughly rubbed down with oil, forms the white-lead of the painters. Besides this, the uses of which are so well known, several other white pigments are made from this metal—namely, flake white (only a fine kind of white-lead), French white, Venetian white, &c.; also the beautiful yellow colours known as chrome yellow, Naples yellow, and patent yellow; and the red colours known as chrome red, orange red, and the well-known red-lead, all of which are of great importance in the art of painting.

"The oxides of this metal (iron), occurring as they do most abundantly in nature, and possessing rich shades of yellow, red, and brown, were probably the first pigments employed by man when he painted his own face instead of having his face painted. The Indian red, light red, umber, terra di Sienna, and the various coloured ochres, hold their place on every palette, and constitute the soundest and most certainly permanent of all the colours in use; and the natural supply of these are so abundant that there is no need for manufacture, careful trituration and levigation being all that is necessary.

"There are two other colours becoming day by day more familiar to the careful painter, who looks to the future as well as the present, namely, the cadmium and strontium yellows, which quite rival the brightness and beauty of the chromes, and far surpass them in stability. Cadmium—rather a rare metal, chiefly obtained as a product of the process of smelting zinc—when combined with a proper proportion of sulphur, forms the beautiful orange yellow sulphuret called 'cadmium yellow;' and strontium, in its chromate, yields a bright and delicate canary yellow, which is very permanent. To the curious fluid metal, mercury, or quicksilver, we are indebted for the valuable red pigment vermilion, one of the most ancient of the artist's materials. It was well known to, and largely employed by, all the civilised nations of antiquity; we see it on the pictured walls of the Assyrians and Egyptians, and it was one of the chief decorative materials of the Greeks and Romans; but the vermilion of those nations was the native ore of quicksilver, which we call cinnabar. They were unacquainted with the art of making it, although it was probably known from a very early period to the Hindoos and Chinese, and the latter are still unrivalled in the art of making it. We have obtained the word vermilion in a curious way;—it is this: on a species of oak in southern Europe and Asia, an insect, known to naturalists as the *Coccus kermes*, is found, and as it in one stage resembles a red berry, it was assumed by the Romans to be one; but finding, on opening it, the parts of a live insect, they believed it was transformed into a little worm, '*vermiculum*.' This *coccus* or *kermes*, as it is now called, yields a beautiful crimson dye; hence its name, *vermiculum*, now changed to vermilion, became a generic distinction for a scarlet colour, and it was in time applied to the mineral pigment, which superseded the use of the insect dye. The Romans generally called it *minium*, and there is every reason to believe they confounded cinnabar (red sulphuret of mercury) and red-lead, although it was certain that one variety of the quicksilver ore was especially known and designated *cinnabaris* or *rubrica* by the Romans, and by the Greeks *Miltos*. With this one colour were probably executed the first pictures of Greece, in a style which was called 'monochromata,' a fashion known also to the Romans, who used the pigment to colour their statues, and even their living generals, as in the case of the statue of Jupiter, and of the general, Camillus, mentioned by Pliny. But the ancient 'monochromata' were not all painted with this colour; some were painted in white by the magnificent Zeuxis, of Heraclea, which were as famous in their time as the wonderful *Camaieu* paintings of Jacob De Wit, Roenstraeten, and other painters of the Dutch school are at the present time. Vermilion is now manufactured chiefly in England and Holland, its most extensive use probably being the colouring of sealing-wax.

"Cobalt is another metal which ministers to the wants of the artist, and furnishes him with a most beautiful colour. It also supplies the glass-stainer with the only rich blue colour yet known. This metal is never found native, but usually occurs in the form of a dark grey, stony ore, of most unpromising appearance. It is obtained chiefly from the copper-mines of Norway and Sweden; and not very long ago its hard veins running through the lodes of copper were considered a great evil by the miners, who attributed their frequent occurrence to the spite of evil-disposed sprites called *kobolden*, whence our name of cobalt for the metal. Long after the commencement of this century, a prayer was read in the churches of Norway praying for protection from the *kobolden*. Now, however, that mist, like many others, has been dispelled, and the cobalt ores, which are so useful to the painter and others, are of more value than the copper itself. The Thenard's or cobalt blue, so useful to the painters, and for its quality of colouring glass, is also invaluable to the enameller, whose blues

are all obtained from this source, as it admits of a range of shades from the light turquoise to violet blue.

"Chromium is the only other metal which will now be mentioned, although several others administer less directly to the requirements of Art. In a metallic state it is very rarely seen, but its sesquioxide, under the name of *chrome green*, is one of our most beautiful opaque green colours, of especial value to the enameller; and its combinations with lead and potash produce the fine yellows so well known as chromes. It is usually associated with iron, and is found in large quantities combined with the iron ores of many parts of the world.

"Besides these, there are some so-called non-metallic minerals, which especially subserve the purpose of the artist; first amongst which is the exquisitely beautiful lapis-lazuli, or azure stone, remarkable for its peculiarly fine blue colour, which, when prepared for use, is called *ultra-marine*. This charming mineral, which is ranked amongst precious stones, although usually ranged with non-metallic minerals, may in truth be traced back to the two metals sodium and silicon, which are found combined in it. The beauty of the stone is greatly enhanced by a number of specks of gold-like iron pyrites, and of some white material. It was very highly prized by the ancients, who gave the names of *cyanos* and *sapphiros* to its two varieties; and it is curious to observe that the method of making an artificial lapis-lazuli was said to have been discovered by one of the kings of Egypt, and the Egyptians were very proud of the invention. What this artificial stone was composed of is unknown now; very probably it was only the blue glass often found in the form of small rings, &c., in tombs, and which is also spread as a blue glaze over the little earthen figures of deities found associated with them; but it is not likely that this artificial production, formerly the glory of an Egyptian king, was the same as that which constitutes the glory of the French chemist, Guimet, who, in 1828, having carefully analysed the true lapis-lazuli, succeeded, by synthetical combination of its component minerals, in reproducing an excellent imitation of the real ultra-marine—the name given to lapis-lazuli in the state prepared for the painter's use. This extraordinary discovery has almost annihilated the manufacture of the pigment from the natural stone, and has so reduced the price of ultra-marine that a pound can now be obtained for the same price which was formerly given for a scruple of the native sort, or more than five hundred times cheaper; besides which, considerable variety of tint can be produced in the artificial sort, and, as far as can be seen, its permanency is equal. This cheapening of so important a colour has had immense effect upon those branches of decorative Art applied to the interior of buildings, and has enabled us not only to rival, but to surpass the ancients in our colour decorations.

"The decaying vegetable matter of which peat-bogs are generally composed is also seized upon by the artist and made to live again upon the canvas. From this material, and also from decayed wood, are made the two fine brown pigments called Vandyke brown and Cologne earth. Their employment in painting is very extensive; and as they mellow by time, much of the rich mellow toning of old pictures is due to that quality. This effect is now almost produced by the use of asphalte as a pigment, the best of which is that called 'mummy,' which is a compound of bituminous and resinous matters found in the Egyptian mummies, being the preservative materials used in embalming the bodies; but it is very questionable whether the artist is even justified in using this material, the composition of which can never be relied upon,—certainly he ought not to employ it except very sparingly, as it is liable both to crack and to run, and has already caused the destruction of many otherwise fine paintings."

Passing to the vegetable kingdom, Professor Archer says:—

"The instability of vegetable colours generally prevents the artist from drawing much from this source; nevertheless the water-colour painter finds some of these colours indispensable. Thus we obtain from the Siamese, Gamboge, which they procure by wounding the leaves and twigs of a species of *Garcinia*—not certainly known to botanists—and for several mornings afterwards removing the thickened yellow juice which has in the meantime exuded. This is kneaded into lumps or rolled into pipes or sticks, and when quite dry is ready for use. Its extraordinary value to the water-colour painter is too well known to require comment; none of his pigments are of more essential utility.

"Another oriental plant, which waves in vast fields on the Indian plains, and now also in many other tropical and sub-tropical countries, is the indigo (*Indigofera tructoria*), which yields enormous quantities of one of our most valuable blue dyes, and also constitutes one of the most useful blues amongst the water-colours. The history of the manufacture of this colour is very strange. After the plant has been harvested, it is placed in large tanks of cold water, to which it gives a yellow colour. This coloured water is drawn off into proper receivers, and is then much agitated with poles or otherwise, until all the yellow matter in the water becomes oxygenised by contact with the air, and turns blue and heavy, sinking to the bottom of the receiver as a dark blue paste, which is afterwards carefully dried, and cut into cubes and packed for export.

"Madder and burnt madder are also two well-known and useful colours, obtained from roots of a weedy straggling plant, originally a native of the south of Europe and the Levant, but now cultivated in most of the European countries and in many parts of Asia. Like indigo, its most extensive use is in dyeing, in which art it is, perhaps, the most important of all colours; but it is not of such essential importance to the painter in water-colours as the two last mentioned.

"The only other vegetable water-colour of importance is sap green. It is made by drying and hardening the juice of the berries of the blackthorn (*Rhamnus catharticus*). The process of manufacture is extremely simple. The berries are carefully separated from their stalks, and a large quantity placed in a tub, and set by for seven or eight days, during which they ferment. The juice is then squeezed out and strained, and to each gallon about two ounces of alum are added; the whole quantity is set in a sand bath to evaporate until it is rather thicker than molasses, when it is poured into bladders, and hung up to harden, after which it is fit for use. With some artists this is a favourite colour, and probably would be with many more if it could be depended upon, but the temptation to imitate it with the much more easily obtained juice of privet berries is so great, that it is unsafe to trust to it, the spurious sort being very liable to change its colour.

"The oils used by painters are all of vegetable origin, and since the days of the Van Eyks have been considered indispensable. The most important are the Hazel-nut Oil, Linseed Oil, and the essential oil of the pine tribe called Turpentine. The Nut Oil is *par excellence* a painter's oil. Its specific gravity is light (being 0·9260) compared with that of linseed, which is 0·9347. It has greater drying qualities, very little colour, and is in every respect superior as a vehicle for pigments to the best linseed oil. This oil is so liable to adulteration, that many careful artists, who think no time misspent which is taken to ensure durability in their work, prepare it themselves. It is a tedious process, and to be done well requires, first, removal of the shells from the nuts, then pounding them in a very clean Wedgwood mortar until they form a paste. This paste is put into a strong horsehair bag, and submitted to great pressure between two pieces of board, usually applied by means of two extemporised levers. The author has seen an ingenious artist convert two pieces of an old easel, and two small boards, almost instantaneously into an oil press, which answered excellently for squeezing out half a pint of nut oil. Under proper management, hazel nuts yield about sixty per cent. of oil, but not much more than half this quantity is obtained by the amateur oil-presser. After pressing, it requires to be clarified, and is then almost colourless and tasteless. The oil of walnuts is often used instead, and is nearly, though not quite, as good.

"Linseed oil is expressed from the seeds of the Lin, or flax plant, after being previously ground into a coarse meal. This is put into strong bags, and submitted to the action of hydraulic presses, or machine-worked stampers, and the oil is so completely expressed that the cake is turned out so dry and hard as only to be broken with difficulty. It is best suited for the painter's purpose after it has undergone a chemical process called *boiling*, which consists in boiling it with litharge (the fused yellow protoxide of lead) and acetate of lead. This process requires careful manipulation, and its result is to give a drying power to the oil, which will enable it, when laid on in thin layers, as in painting, to dry in a few hours, and in drying to form a fine varnish-like coat. The thinness of this layer, and its tendency to dry, are both increased by the use of the third oil, viz. turpentine, which, as before stated, is an essential oil; that is to say, it is volatile, and is procured by distillation, instead of compression, from the resinous exudation of several species of the pine or fir tribe. It is so well known that no description is needed. It acts as a diluent to the other oils, when used as vehicles for the paints, and thus, by greatly extending their surface, very much facilitates the drying process. Moreover, as the volatile character of the turpentine leads to its evaporation from the paint before it is completely dry, the escape of its particles from and through the skin of paint breaks up the surface, so as to lessen the too varnish-like gloss which would be the result of using the oil alone. This peculiarity is much used amongst house-painters, who diminish the glare of common house paint by 'flatting,' as it is called, with 'turps,' or turpentine."

"The animal kingdom also furnishes some of the colours used by artists, and foremost amongst these is the useful Carmine. If we wish to glance at the origin of this beautiful colour, we must examine the Prickly Cactus on the dry plains of Mexico, and we shall see crawling on it a bright scarlet-bodied insect (*Coccus cacti*), ugly in shape and wingless. This is shaken off and killed by heat; it is afterwards dried, and becomes part of the commerce of the world, under the name of Cochineal. The colour-maker takes a quantity of this material, and having crushed it to powder, and boiled it in water in the proportion of about four gallons to a pound, after settling until the liquid is perfectly clear, it is poured off, and is then of a brilliant crimson colour. To this is added a solution of the bichloride of tin, and immediately a fine precipitation takes place upon the sides of the vessel. When this ceases, the water, now nearly colourless, is carefully drawn off

by means of a syphon, and the precipitate is allowed to dry, when it readily peels off from the sides of the vessel, and is then fit for use as a pigment. There are many other ways of making it, according to the fancy of the manufacturer; but the one just given is held to be a very good one, and affords the most concise idea of its preparation.

"Another insect, closely allied to the Cochineal, is found on certain trees in India, and principally in Burmah. These are the lac insects (*Coccus lacca*). At first they move about freely; but as they proceed with their metamorphosis they secrete a peculiar substance, which, properly prepared, is the Shell-lac of commerce, and the material from which our French polish and sealing-wax are made.

"Not only do we draw the teeth, strip off the shells, and parch and boil the bodies of those animals whose materials we thus enlist into the service of Art, but we also make the diseases of one, at least, subservient to the same purposes. Thus that exceedingly beautiful colour with which flower painters colour the delicate anthers of many flowers is actually the produce of a serious disease in the liver of the ox or cow. This disease causes the formation of a biliary calculus, or gall-stone, in the gall-bladder of the poor animal, and this, which is carefully sought for by the butchers, who know the value of the perquisite, is ground down and made into the very costly cakes of yellow colour known as 'gall-stone.' The bile, too, of these animals is also often used by water-colourists, in consequence of its wonderful power over grease.

"During the last thirty years a great change has occurred in the matter of pigments; the gas works of this country were placed in a most awkward position on account of enormous accumulations of refuse matter, for which they could find no purchasers, and were compelled to keep on their premises at the cost of a large amount of space, when chemistry found that in those unsavoury liquids and pasty matters lay the principles of a whole series of dyes, which have since been so widely known as aniline colours. Much interesting matter connected with this and other subjects connected with Art manufacture will be found in the two series of lectures delivered at the Society of Arts, soon after the closing of the Great Exhibition of 1851, and which form a single small volume, printed for the Society; and in the admirable 'Cantor Lectures' delivered before the same Society, and which are printed and sold separately. Amongst these may be mentioned the lectures on the 'Aniline or Coal-Tar Colours,' by Mr. Perkins; 'Dyes and Dye-stuffs, other than Aniline,' by the late Dr. Crace Calvert; and 'Silicates, Silicides, Glass, and Glass-painting,' seven lectures, by Mr. Barff. It is right to mention here that, although the tar colours have been most extensively adopted—adopted so much as to have reduced the imports of madder and its derivatives, which were formerly very important, to almost nothing—they have not yet been used in the manufacture of pigments for painting."

Some years since Mr. William Linton, the artist, drew up a table of oil-painters' colours, with notices of their chemical and artistic qualities, which has since been reprinted in Ure's and other Dictionaries of the Arts, and may be useful to Art-students and others.

It has been remarked as curious that the pigments which we use to represent leaves, flowers, and other brilliant objects are very rarely derived from these, but from roots, minerals, and other matters.

Chinese and Japanese have always been famous for the beautiful colours which they give to their textiles and other manufactures, and the peculiar quality of a certain green colour—namely, that it underwent no change in appearance under artificial light—always attracted attention. Since our knowledge of China has been enlarged, we have learned that this Chinese green is actually derived directly from a certain plant, or plants, and is not the produce of a mixture of yellow and blue. Hence, probably, the fact that the colour is shown equally well by gas or candle light as by that of the sun. This fact has also been used in support of the views of some men of science, that the idea of there being but three primitive colours, as generally supposed, is erroneous: here, at any rate, we have a truly original green pigment. The preparation of this Chinese green has been described several times, and many documents relating to the subject published by M. Natalis Rondot, at the instance of the Chamber of Commerce of Lyons, which naturally felt an intense interest in the subject in connection with silk-dyeing: but since the publication in question, M. Paul Campion, in his valuable work on the "Industries of China," has given a clear account of it, from personal observation in the country on several occasions. He says that in the month of November large junks arrive at Han-Keou, loaded with bark for the production of this pigment, which is obtained from several varieties of *rhamnus*. The bark is cut up in small pieces and placed in a cast-iron boiler, which is nearly filled with bark and water, and the whole is kept boiling for some hours; the bark and water are then turned into large earthen vessels and left till the next morning. When the liquid is required to be used, it is drained off through bamboo strainers, and the bark when dry is used for fuel. To the liquid dye is added a weak solution of carbonate of soda, obtained from the calcination and washing of the ash of oil-cake; it is then of a dark brown colour and ready for use. The dye is now carried into the meadows in pails, and long pieces of cotton stuff are steeped in it, drained, and laid down upon the grass to dry. The time has to be carefully chosen, neither too hot nor too cold, and the operation has to be performed early in the morning before the sun has much power, as it would then spoil the colour. The early part of the month of June is the time for the operation. The brown colour soon changes under exposure to what is known as Chinese green. The cotton when dry is steeped and laid out a second time; and this has to be repeated from ten to fifteen times, according to circumstances, until the desired tint is obtained. When of the right colour the cotton is sold to other persons, who extract and sell the pigment. It is only the face of the cotton exposed to the action of the sun which is of a dark green, the under surface being of a much lighter colour. It is plunged into boiling water, which detaches the pigment, and the liquid having been evaporated to a syrup, the latter is laid on sheets of paper to dry in the open air, and the colour assumes the form of thin crumpled sheets. Sometimes a more rapid result is obtained by plunging large hanks of cotton-yarn into the original liquid several times and then dyeing them. In 1865 this pigment was worth in China 225 francs per kilogramme, or more than 80*s.* per lb. It is far too dear to be employed for any other purpose than silk-dyeing. It must be admitted that this is a curious process, and it is supposed to have been practised for hundreds of years, with such beautiful results as we know.

Some years since the late M. Persoz, one of the professors of applied chemistry at the Conservatoire des Arts et Metiers, succeeded in producing a natural green pigment of this kind from the leaves, if our memory serves rightly, of the buckthorn, and it was introduced into commerce at a very high price; just then, however, analine green was discovered, which possessed the qualities of brilliancy, of appearing the same by all lights, and of cheapness. It is curious that we should have become possessed of a method which the Chinese have practised for no one knows how many ages, just as modern science by an extraordinary application of refuse should have rendered it useless to us.

New pigments and modes of decoration are constantly being introduced or proposed, and such propositions often contain valuable suggestions, even should they not quite answer their intended purpose. The following account of an enamel paint is from the *Journal of the Society of Arts*, of London:—

"One of the most recent inventions for painting or coating surfaces is a new paint brought out by Mr. Thos. Griffiths, of Liverpool, which has the property of forming a firm impenetrable enamel on the surface of the article to which it is applied. By this means the surface is rendered absolutely waterproof, however porous it may be. The material is consequently intended, not only for decorative purposes, but to be applied as a waterproof coating to the walls or foundations of dwelling-houses, railway arches, bridges, tunnels, viaducts, and other structures of brick, plaster, wood, or iron. It is also stated that the paint is well adapted for covering the bottoms of vessels or submerged structures of any description. Various trials have at different times been made of it. At Portobello it was tried on some iron plates, and these were immersed for three months in sea-water. At the expiration of that time the plates were taken up and examined, when it was found that they looked fresh and clean as ever, and quite free from seaweed; and, on some of the enamel being scraped off, the metal showed no signs of rust, although similar plates, treated with other kinds of paint, and immersed in the same way, were both foul and greatly oxidized. As a second test, some of this paint was applied to the steamers trading to Africa from Liverpool; and these also showed no corrosion on their return. It is also said that its smooth surface gives it a considerable sanitary value, and for this reason, as well as that it defies the attacks of white ants, the huts used for the soldiers in the Ashantee expedition were coated with it. The walls of the huts, which the paint will make smooth and polished like glass, could be washed with soap and water or disinfecting fluid. This enamel is also available for painting the walls of hospitals, fever wards, &c., as the porosity of the plaster is entirely stopped, thus preventing infection from lodging. It can be made of any colour. White and chocolate are generally used. Various processes for the preservation of ships' bottoms from fouling have from time to time been noted and described in the *Journal*, and the patents on the subject are very numerous. The earliest of these was taken out in 1695 (No. 341) by Charles Ardesoif, for 'A new invented composicion which will preserve ships from the worms, insoemuch that any ship may by virtue of the same continue at sea for the space of four or five yeares without receiving any damage from the worms.' Since that time very various methods have been employed with greater or less success. The chief merit claimed by Mr. Griffiths for his invention is that of simplicity of application, as it is simply spread on with a brush, like common paint, and sets quite firm in about an hour, even on a wet surface. It is stated that the Liverpool Silicate Paint Company have purchased the sole right of sale and manufacture of the article."

In the same journal we read that:—

"Herr Puscher, of Nuremberg, has recently invented a simple process,

depending on the use of acetate of lead, which renders every kind of *painting* applicable to sheets of *zinc*. By mixing black-lead, for instance, with the salt, a very agreeable reddish-brown is obtained. It is by these means that the cupola of the synagogue at Nuremberg has been painted; and for more than a year, during which his work has stood, the atmosphere has had no influence on the zinc sheeting of the roof. By the addition of other colouring matters, the lightest or darkest shades of grey or yellow may be produced. It is this circumstance which gives to zinc mouldings quite the appearance of being sculptured in stone. For writing with dark ink on sheets of zinc, the inventor employs a solution of chlorate of copper. After a few minutes the zinc sheet is washed and then dried."

In another journal we find the following:—

"Professor Böttger recommends the following as the simplest method of giving paper and wood surfaces a crystalline coating:—Mix a very concentrated cold solution of salt with dextrine, and lay the thinnest possible coating of the fluid on the surface to be covered by means of a broad soft brush. After drying, the surface has a beautiful bright mother-of-pearl coating, which, in consequence of the dextrine, adheres firmly to paper and wood. The coating may be made adhesive to glass by doing it over with an alcoholic shellac solution. The following salts are mentioned as adapted to produce the most beautiful crystalline coating, viz.: sulphate of magnesia, acetate of soda, and sulphate of tin. Paper must first be sized, otherwise it will absorb the liquid and prevent the formation of crystals. Coloured glass thus prepared gives a good effect by transmitted light."

In the decoration of large surfaces stencilling is often employed with excellent results as regards saving of time. The design is drawn or transferred to sized paper, which may be doubled in case of patterns having a centre and like ends, and then cut out with a penknife, leaving where necessary connecting pieces of the paper to prevent the stencil falling to pieces. By such means the decoration of the interior of the International Exhibition of 1862 was accomplished very quickly: and generally, when the outlines and least important parts of a design are got into place by stencilling, and the more delicate portions are finished off by hand, the result is all that can be wished. In using the stencil but little colour is employed, and that rather thick; stumpy camel-hair pencils are generally used for the work. When stencilling is used in place of paper-hangings, the stencil plate is cut in zinc or other thin metal.

Numberless mechanical methods of decorating wood and other work have been tried with more or less success. Several are described in the following words in the *Journal of the Society of Arts* of December the 12th, 1873:—

"The mechanical processes for decorating wood surfaces may be conveniently divided into such as imitate graining, or produce change of colour by staining, and such as use the wood as a ground for the production of designs, and thus enter the domain of imaginative or fanciful art. Of mechanical methods for imitating graining by reproducing the markings existing on the natural wood itself, four have obtained publicity in the *Journal* of this Society; the first to call attention to the process having been Signor Felix Abate, of Naples, who, on January 23, 1854, speaking of his discovery, says:—'This invention constitutes a new art, by means of which natural or artificial objects can be represented and imitated by printing directly from the objects themselves upon any suitable substance. . . . . Suppose a sheet of veneering wood be the object from which impressions are to be taken. I expose the wood for a few minutes to the cold evaporation of hydrochloric or sulphuric acid, or I slightly wet it with either of those acids diluted, and then well wipe the acid off from the surface. Afterwards it is laid upon a piece of calico, or paper, or common wood, and by the stroke of the press an impression is taken, which is, of course, quite invisible; but by exposing this impression immediately after to the action of a strong heat, a most perfect and beautiful representation of the printing wood instantaneously appears. In the same way, with the same plate of wood, without any other acid preparation, a number of impressions, about twenty or more, are taken; then, as the acid begins to be exhausted, and the impression grows faint, the acidification of the plate must be repeated as above, and so on progressively, as the wood is not in the least injured by the working of the process for any number of impressions. All these impressions show a general wood-like tint, most natural for the light-coloured woods, such as oak, walnut, maple, &c.; but for the woods that have a peculiar colour, such as mahogany, rosewood, &c., the impression must be taken, if a true imitation be required, on a stuff dyed of the light colour of the wood.' 'Such,' states Signor Abate, 'is thermography, or the art of printing by means of heat.' Of similar intention, but differing somewhat in detail, is the process of Mr. William Dean, described by him on January 27, 1869, as follows:—'Select a piece of wood of fine quality, about five feet long, twelve inches wide, and a quarter of an inch thick; it is, to use the technical phrase, cleaned up by the cabinet-maker on both sides, and is well sandpapered down. By having both sides of the board cleaned up, two patterns are obtained from the same board. A chemical preparation is then applied to it, which has the effect of opening the pores of the wood, and, at the same time, of hardening the surface, and, when the board is thoroughly dry, it is ready for use. . . . . . The material used for taking the impression is prepared in oil, and is specially adapted for the purpose of transferring. The paper, too, is manufactured for the purpose, and is very thin but tough, so that it can be successfully applied to any irregular or moulded surfaces, and it is sized, to prevent the colour from becoming incorporated with the body of the paper. A small wood roller is used for spreading the colour on the board, and a large, broad, flexible palette-knife is used for taking the superfluous colour off. That being done, the sized paper is placed on the board, and both are turned through a small machine having turned iron cylinders, the upper one being covered with double-milled flannel; the paper is then taken off the board, its printed surface is applied to the article to be decorated, the back of the impression is lightly rubbed with a piece of soft flannel, and the paper is removed, and an exact fac-simile of the board from which the impression is taken is given.' It will be observed that while Signor Abate's process is one for printing direct from the wood itself, Mr. Dean's is that of obtaining an impression on wood or other substances by means of transfer. It is by transfer, also, that the small fancy articles made of wood, such as trays, saucers, &c., known as 'Tunbridge ware,' are ornamented with views of buildings and landscapes. Among recent methods of staining wood, that patented by Messrs. Trollope and Sons, under the title of Xylotechnography, deservedly attracted attention in the London International Exhibition of 1871. It is described as 'staining by hand or stencil a light-coloured, but not necessarily soft, wood with certain transparent colours, producing a result when polished similar to inlaying.' Of the mechanical processes by which wood is decorated with designs, stencilling is so well known that description is superfluous. For rendering broad, simple effects, its utility is indisputable, but it is manifestly unequal to the representation of designs expressing the qualities of delicacy and intricacy. Pretty imitations of sepia drawings have been executed on wood with hot irons, and a method for the mechanical production of such effects was introduced by Mr. Brigg in 1859. His method is that of charring the surface with engraved cylinders, heated with gas, which enables the degree of heat to be regulated, and the extent of char to be controlled. . . . . After the surface has been charred sufficiently to yield the greatest amount of shadow required, the whole surface is rubbed down and then polished or varnished. By this means imitation-grained surfaces are obtained of great durability, and at a cost not exceeding grained work produced by the ordinary processes of painting and varnishing."

A method of printing on wood has been invented and put into practice by Mr. Thos. Whitburn, and was thus described by him before the same society in 1873:—

"The process for the mechanical production of designs on wood, for which I have obtained a patent, has not a pictorial, but a distinctly decorative intention. It is fitted to express on flat surfaces of wood either flat effects of light figures on a dark ground, or dark figures on a light ground, or figures light and dark in parts on a ground intermediate in shade; and these effects are produced on the wood by an adaptation of the processes of engraving and printing.

"The specimens are printed on wood, from engravings from my designs, executed on wood blocks, and also from electrotypes from such wood blocks. The kinds of wood which are best adapted for receiving such impressions are those which are light in colour and soft in grain, such as pine and lime trees, which I have here employed. The conditions under which the impressions are taken are precisely those essential to the production of prints on paper, namely, that the surfaces of the engraved block and of the substance taking the impression must be throughout in perfect contact. The specimens here shown were produced in an 'Albion' hand printing press, with ordinary printers' ink. Such impressions, being polished or varnished, are necessarily as durable as the wood itself. As regards the colouring material for producing the impression, I may remark that the process is by no means limited to printer's ink. The object, then, of this process is to multiply designs of a decorative kind at a cheap rate; and such designs may, I conceive, be applied to all purposes and situations in which flat surfaces of wood are or may be used; and especially for friezes, dados, panels, and borders, either for walls, architectural adjuncts, or furniture."

Messrs. Whitburn and Young have set up works for the execution of Xylography at Milford, in Surrey, with an office in London.

Another mode of decorating panels of oak cabinets, sideboards, &c., is that of Mr. Hubert Herkomer, who uses Stephens's wood stains on well-selected horse-chestnut: the designs are drawn upon the wood, and when the work is completed it is polished, and thus the drawing secured. The 'wood stains' referred to are those used for colouring flooring, and are of various tints, representing oak, walnut, mahogany, and other woods.

Besides oil painting, the two ancient methods known as *tempera* and *fresco* are both specially adapted to wall decoration: the former of these is

peculiarly simple; it consists in painting in water-colour. Eggs, gum, glue, or size were used to fix the colour on the wall, and the picture when finished was dressed with oil or some albuminous matter—white of egg probably. Many of the finest pictures in Italy are in tempera, which has proved exceedingly durable.

Fresco painting differs essentially from all other kinds, being an incorporation of the pigments used with fine fresh plaster upon the face of a wall; hence its name *fresco*, fresh.

The nature of the work requires great rapidity and skill in the painter; all that is begun in the morning must be completed in the evening while the plaster is wet, as any subsequent re-touching destroys the purity of the work. The general practice of this art relates to the following particulars:—1, the cartoon; 2, the preparation of the wall; 3, the painting; 4, the colours and implements used. Since the artist is unable, without injury to the general effect, to re-touch a fresco painting, it is the more important that he should prepare beforehand a finished coloured sketch of the subject he intends to represent, and also a full-sized chalk drawing of the same. For this latter purpose he prepares a cartoon, by straining strong cloth on a frame, and then glueing layers of paper to the surface, which must be kept smooth and even, and finally prepared to receive the drawing by a preparation of size and alum. The drawing is made with charcoal, and when finished and fixed, an outline is traced from it on oiled paper. This is the working outline, a portion of which, corresponding with the quantity of fresco painting which can be executed at one time, is nailed to the wet wall, where the forms on the oiled paper are gone over with a sharp point so as to make a distinct indentation on the soft plaster beneath. Another way of producing the outline on the wall is to place the tracing-paper first at the back of the cartoon, and prick the figures through, then to lay the pricked paper on the wall, and dust a black or red powder on it from a muslin bag. This produces a dotted outline on the plaster, and leaves the surface without indentation; but it injures the cartoon, and also gives less decided lines to work by. That both these methods were practised by the most celebrated painters is evident from the pricked outline being visible in some of the works of Caracci and Raphael, and by the indented outline produced by tracing being likewise seen in some of the best Italian frescoes.

The preparation of the wall for fresco painting is a matter of great importance. The chief thing to be dreaded is damp; therefore all old mortar is removed, and the solid wall laid bare, preparatory to a new coat of approved materials. This consists, in the first place, of lime and river sand, laid on roughly, and left to become perfectly dry and hard, before the smoother layers are added. The lime has to undergo careful preparation and seasoning before it is fit to be thus employed. The method of seasoning it adopted at Munich is as follows:—A pit is filled with clean burnt limestone, which is slaked, and then stirred continually till it is reduced to an impalpable condition. The surface having settled to a level, clean river-sand is spread over it to the depth of a foot or more, so as to exclude the air, and, lastly, the whole is covered with earth. Thus it remains for two or three years before it is used either for painting (lime being the white pigment) or for coating walls.

The final preparation of the wall consists in wetting it till the first rough coat will absorb no more water, then laying on a thin coat of plaster, and when this begins to set, adding a finer coat, containing more lime and less sand. When this is done the work is smoothed with a wooden trowel; but only so much space is finished in this way at one time as can be painted on before it gets dry.

The wall thus prepared, the outline has to be obtained from the cartoon in one of the two ways already described. The colouring can be commenced as soon as the plaster is in that state in which it is damp enough to receive the impression of the finger, and not wet enough for the colours to run: if the drying goes on too rapidly, the surface of the plaster must be sprinkled from time to time with water. The colours, ground fine in water, are abundantly supplied to the artist in pots or basins, and several palettes are at hand to work from. Tiles, or other absorbent materials, are used to try the colours on, and to give the artist an idea of their effect when dried into the plaster. When the artist concludes his work for the day, he cuts away any portion of the prepared plaster which he has not used, taking care that the division is made in the folds of drapery, or in some other part of the painting where it will be unobserved: on commencing the next day's work he takes care to wet the edges of the finished part, and make them amalgamate as nicely as possible with the new plaster. The drying of the plaster is sometimes arrested by foreign artists by keeping wet linen stretched over the surface of the picture, and pressed to it by a cushion of waxed cloth: this enables them to finish in the morning what they were unable to complete overnight. Defects in a painting are remedied by cutting out the imperfect part, laying in new plaster, and painting that portion over again. There are also various devices for heightening the effect of finished frescoes, but these are all objectionable, as impairing the durability of the work, and were not, we believe, used by the great masters.

The colours used in this art consist chiefly of earths and a few metallic oxides variously prepared. Animal or vegetable substances cannot be employed, because the lime would destroy them. Brushes of hogs' hair, and smaller pencils of otters' hair, are found to resist the action of the lime. Distilled water should be employed in all the operations connected with fresco painting.

Many valuable ancient paintings in fresco have been saved from destruction by ingenious modes of transferring them from badly constructed walls to canvas. An attempt of this kind was made at Brescia, in 1829, by Mr. Ludwig Gruner, and met with perfect success. The frescoes existed on the old walls of the convent of St. Eufemia. These were first thoroughly cleaned; a strong glue was then passed over the surface, to which a sheet of fine calico was affixed; other layers of glue and of calico were then added, and the whole so amalgamated by heat as to become of one substance with the plaster of the wall. The whole was then torn away, leaving the wall white, and the fresco adhering to the glue. To detach it, a still stronger glue, and one that resisted moisture, was applied to the back, which was secured to canvas. The subsequent application of tepid water gradually caused the calico and glue to loosen their hold, and left the fresco in its new position.

A new mode of fresco painting, the invention of which is ascribed to a well-known German chemist, Obergrath von Fuchs, consists in the use of a solution of silex instead of lime, and in the employment of a chemically prepared ground, which becomes exceedingly hard and can be worked on repeatedly without detriment to the general effect.

This it is believed will, when properly applied, produce a permanent picture; but, unfortunately, one of two remarkable works by the late Daniel Maclise in the Palace of Westminster, the "Field of Waterloo" and the "Death of Nelson," which were executed according to this new system, has shown some alteration; but this is said to have arisen from an error committed in the early stage of the work, and before the preparations were completed.

The matching of colours, or rather of pigments, is a matter of much difficulty, especially as colour-blindness, or partial colour-blindness, is said to be extremely prevalent, and we may therefore mention a very ingenious proposal made by Herr Otto Radde, of Hamburg, the inventor of a new system of polychromatic printing called "Stereochromy," who having, it is said, found the means of obtaining paper free from all starch and chemicals and unalterable pigments, has produced examples of what he calls "colour pages," that is to say, printed specimens of colours numbered and lettered for reference, so that persons possessing the "Guide" may communicate with each other, and supply or indicate precisely the tint of any colour required. Herr Radde proposes to tabulate all the colours, about eighty, each with twenty-one equal gradations—that is to say, eleven tints up to white, and eleven shades down to black; and as each card will have its own distinctive colour and each gradation thereon a letter, reference to any given tint will be perfectly simple.

Before quitting this subject we may state that a catalogue of the mural (wall) paintings in this country was published four or five years since by the authorities of the South Kensington Museum.

We may also mention a work by Dr. C. Dresser, on the "Principles of Design," which treats specially of Colour, Furniture, Decoration of Buildings, Carpets, Curtain Materials, Hollow Ware, and Stained Glass.

As an appropriate conclusion to this chapter are offered extracts from a paper read last year by Mr. J. G. Crace, before the Artisans' Institute, London, in 1875, on "Decoration and Colour."

"One of the great questions of the day was how to educate and train the Art-workman so that he might take such a place in the trade or handicraft that he was to follow as workmen of the same class in a foreign country. With regard to the present subject, decoration was the art of adorning the objects that they used, and the houses they occupied. To accomplish this successfully the art should ever be accompanied by its handmaidens—knowledge and taste. In the study of any art it was necessary to understand thoroughly the rudiments of the first principles of the art, and to teach these was one of the great objects of technical education. To decorate an object appropriately it was necessary to consider the material of which it was made. From the beginning they must work on certain principles. Let the construction be evident, and if carving or inlaid ornament be introduced, let it form a feature with the construction, and not overlay or disguise it. A proper disposition of well-proportioned forms was the first consideration. With respect to colour decoration as applied to the adornment of dwellings, it should be the ambition of every man to have his home clean, comfortable, and tasteful; and a knowledge of the rudiments of the science—for it was a science—must be useful to every man. Colour gave life to form; its variations, properly harmonized, delighted the eye, and had a powerful influence on the mind when treated with the skill which a careful and well-trained study of the art would enable them to exercise.

"To study properly the subject of colour they must begin with the consideration of light. When the rays of white light were intercepted or

dispersed colour was produced. Familiar to all of them was the glorious rainbow, which, as Thomson had told them, was

'Born of the shower, and coloured by the sun.'

The rays of light emitted through a prism gave out a series of brilliant colours known as the solar spectrum; and the relations of the colours thus produced formed the rudimentary principles which regulated the science of colour. With regard to harmony—how to bring together various colours in such proportions as to produce an agreeable effect—Mr. Crace said that bright red and bright green, bright blue and bright orange, could not be used together in masses without much modification. He spoke the more earnestly because he believed it was a popular delusion that these contrasts were quite correct. To combine various modulations of colour so that they might mingle together and form a harmonious whole, demanded careful study, practice, and taste. He could not too strongly urge upon those who sought to improve themselves in decorative art to study carefully natural flowers and foliage, both for gracefulness of form and for harmony and richness of colour. In decoration, it might be laid down as a principle that one colour should dominate. In the majority of cases the most perfect and beautiful harmony was produced by employing neutralised hues of colour of the larger masses, and then giving freshness, cheerfulness, and beauty to the whole by the introduction, in small masses, of the primary or secondary colours that might form the proper equivalents to the prevailing colour. It should always be remembered that the eye was never satisfied with any arrangement of colour unless all the primaries were present in some shape or other. In carrying out decorations it would be found that all colours had two kinds of harmony—that of analogy or sympathy, and that of contrast. In churches, large halls, or public buildings of importance, it was necessary to consider very carefully the peculiar circumstances of each of them before designing the decoration or arranging the colours. He was not surprised at architects dreading the indiscriminate use of colour in a building on which they had bestowed so much careful study and labour. Judicious and well-designed arrangements of colour should add to the architectural effect. By these the principal constructive features of a building should be emphasized or clearly expressed; and the whole, avoiding confusion, should present a combination of symmetry of form and harmony of colour. As for himself, Mr. Crace stated he abominated whitewash. He saw not the beauty of interior stone walls unrelieved, nor did he see the impropriety of covering these real stone walls with glowing colour.

"In Egypt there were to be found examples of decorative colouring done nearly 3,000 years ago, and still in fine preservation, and which excited the warmest admiration. The interior walls of the temples were often covered with historical representations brought out in colour; the main architectural features were also painted. In the British Museum and at the Crystal Palace might be seen reproductions of some of these well worthy of their attention. The Greeks, he had no doubt, carried the art of coloured decoration to the same perfection as the other arts in which they so excelled. Their descendants showed by their decorative works, executed in a provincial Roman city 1,800 years ago, how beautifully the art was still practised in their day. The city of Pompeii, submerged, almost forgotten during 1,800 years, and now brought to light again, showed all the details of Roman life as it existed at that distant period. The walls of the houses and public buildings, though roofless, were still glowing with colours, fresh as the day on which the awful calamity overtook the city. It was indeed a mine of wealth to the Art-student. Here he would find wonderful combinations of colour, and the utmost elegance, fancy, and beauty of ornament."

No. 5.—PAPER-HANGINGS, ETC.



HE fashion of covering the walls of apartments with decorative paper-hangings, or, as the French call them, *papiers peints*, was derived, like paper-making, from the Chinese, and England, it is said, was the first country to imitate the specimens of their skill which had been imported hither.

To this art we are indebted for much of the appearance of comfort and respectability which prevails in the houses of the middle and lower classes of this country. The wealthy can, and often do, adopt other modes of ornamentation, but for the professional and working classes, paper-hangings, varying in price and in style, afford the means of clothing the walls of their dwellings cheerfully and pleasingly, and in a more or less elegant manner according to the means of the owner. Paper-hangings, even of the lowest price and quality, may yet, by their simplicity and good taste, greatly enhance the beauty of a cottage, and increase the sense of comfort in its occupants. For there is no question but that the feeling of comfort is largely influenced by the colour and fitness of the objects around us. Who has not felt relieved on entering a room with a cold northern aspect, to find the walls covered with rose-coloured or crimson paperings, or with paper in which the warmer tints predominate; and who has not experienced, on the other hand, a sense of coolness, on finding a room with a bright southern aspect judiciously papered with an admixture of a cold colour, such as bluish green (in contradistinction to the bright yellowish green, which gives a sense of heat rather than of coolness).

The apparent warmth or coldness of a room is not the only point on which it is influenced by the nature of its paper-hangings; its apparent size and height are increased or diminished by the same means. Papers of a large pattern greatly reduce the apparent size, those of a large and flowing pattern the height; a paper in which perpendicular lines predominate, although the pattern be large, does not so much affect the apparent height. To cover a small room with paper of a large pattern is a great mistake; a still worse mistake is to paper the ceiling, as is sometimes done on the Continent.

The best effect is produced by using papers in which the pattern and colours are quiet and harmonious, and do not strike the eye. The walls of a room are like the background of a picture, and should be so treated as to relieve and set off the objects in front of them, and to give repose to the eye. A paper presenting sudden contrasts in colour, and strongly marked lines in the pattern, forms the worst possible background for pictures, and the most unfavourable accompaniment to furniture, draperies, and objects of taste. The spotty effect of such a papering interferes with all the minor objects in the apartment, and gives an unpleasant and bewildering effect. Modern paper-hangings are frequently made to represent columns, friezes, pilasters, &c., dividing the room into compartments. Notwithstanding the beautiful execution of some of these papers, they cannot be recommended as in good taste. The introduction of real objects of the kind would be an absurdity in a situation where their support is not needed; therefore sham pilasters, &c., must be wrong. The introduction of flowers and conventional forms for the ornamentation of our walls is not unnatural; consequently their imitation does not involve an absurdity. It was suggested, a few years ago, that paper-hangings might be made instructive, as well as ornamental, by the introduction of poetical and other sentences of a moral and religious kind. In former days it was not uncommon to have the walls adorned with tablets, containing sentences from various authors, and there are drawings still extant of those which ornamented the apartments of Sir Nicholas Bacon. It has therefore been thought desirable that paperings of a similar kind should be prepared, with compartments, representing tablets in which appropriate mottoes should be printed in the old English or German characters. This custom would be liable to many abuses, arising from the defective tastes of those who had the choosing of the mottoes; but perhaps this is not a sufficient reason why we should discard a practice which might be productive of useful results.

The early method of making paper-hangings was by *stencilling*, as that mode of painting was called, in which a piece of pasteboard, or sheet metal, with patterns cut out in it, was laid on the paper, and water-colours were applied with a brush to the back of the pasteboard, so that the colours were delivered through the openings, and formed the patterns upon the paper. When the first series of colours had become dry, another might be applied with a second piece of pasteboard, and so on, until considerable variety was attained, but at much cost of time and trouble. These processes were afterwards superseded by those of the calico-printer, which were successfully applied to the manufacture of paper-hangings.

In printing by hand, as many blocks are required as there are shades and varieties of colour, except when two colours are purposely blended, as yellow and blue to produce green, &c. It is quite common to see specimens of decorative paper-hangings requiring a large number of blocks to produce the pattern. The labour and skill bestowed on some of these papers is immense, but the effect is not always proportionally good. In fact, the attempt to bring as many colours as possible into one composition is very much to be deprecated. The result may astonish, but it will be seldom pleasing to persons of good taste.

The blocks of the paper-hanger, like those of the calico and floor-cloth printer, consist of engraved pieces of pear-tree or sycamore, mounted on poplar or pine-wood. Each has four pin-points at the corners, which make guide-marks on the paper for placing the succeeding blocks in the same spot. These blocks are pressed on the sieves of colour, and applied in succession with some force to the paper. These sieves or drums are covered with calf's skin, and float in a tub of water thickened with parings of paper from the bookbinders. The drum is kept uniformly covered with colour by a child, who takes up a small quantity on a brush, and distributes it afresh over the surface after every application of the block. The workman, in pressing down the block charged with colour on the surface of the paper, employs a lever to increase the power of his arm, the child drawing away a portion of the paper at intervals across a wooden trestle,—hence the name of *tireur* (drawer) given to the child. When the piece has received one set of coloured impressions, the workman, assisted by the drawer, hangs it up to dry, on poles near the ceiling, to which hooks are attached. If the paper is of the description called flock-paper, the pattern is first printed in size, then with a preparation of varnish, and before this is dry, the coloured flock prepared from wool is sifted over the paper, and adheres to the varnished parts. The preparation of the flock is as follows:—When obtained from the woollen cloth manufacturers it consists of particles cut off by the shearing machines, and may be either white or coloured; if white, it has to be scoured and dyed to the proper tint. It is then stove-dried and ground to a fine powder. This is further prepared by sifting to different degrees of fineness in a bolting-machine. It is then placed in a large chest, or *drum*, whose width and capacity are such that the child can draw the printed paper into it by degrees at its full width, and sprinkle the flock thereon. When about seven feet of papering have been thus drawn in, the child shuts the lid of the drum, and beats with rods on the bottom, which is made of tense calf's skin, and is elevated two feet from the floor by means of strong supports. This beating on the drum raises a cloud of flock inside, which, as it subsides, falls uniformly on the paper. The chest is then opened, the paper is inverted and lightly tapped to detach loose particles. Gradations of colour in the flock are afterwards produced by applying to the surface, when thoroughly dry, lighter or deeper shades in water-colour or in distemper. Gold-leaf is applied to paper-hangings in the same way as to wood, and by means of a preparation washed over it, is made more durable than formerly, and better able to resist damp.

The most marked change that has occurred in the paper-staining trade during the few past years is the great extension of the use of machinery; as yet, however, machine-printed papers are inferior to those printed by hand or by block. As regards quantity, paper printed by the machine far exceeds that done by blocks. In 1862 it was estimated that 16,485,000 pieces were made, of which 14,025,000 were machine-printed, and 2,460,000 were block-printed. Another change is, that whereas formerly the trade was confined to the South of England, it is now carried on in various parts of England and Scotland, London being the chief centre.

The paper is first padded—that is, a ground-colour is laid uniformly over it, upon which the coloured pattern is printed by the machine. The padding is done with French chalk, earthy colours, or coloured lakes thickened with size, which are laid on by means of brushes. For machine-printing the paper is kept in web, and the padding effected by a series of rotary brushes. The paper is also polished with French chalk by the machine. For hand-printing the paper is cut into lengths of 12 yards, and the groundwork is laid by a man assisted by two boys; in some cases as many as 300 pieces can be padded in a day. The man lays the paper flat on a table and applies the colour with a brush; while the boys suspend the pieces, as they are

done, to cross rods connected with the ceiling, to dry. When dried, the papers are rolled up and carried to another apartment, to be polished by friction-rollers and brushers. Pieces that are to be satined are grounded with plaster of Paris, and operated on by a brush attached to the lower end of a swing polishing rod. Talc, or china clay, is sometimes used to give surface, or satiny lustre. The colours used are French chalk, good whiting—which is sometimes mixed with white-lead for whites; for the yellow tints, chrome yellow, *terra di Sienna*, yellow ochre, and vegetable extracts, such as Persian berries, are employed; the reds consist principally of decoction of woods, such as Brazil-wood; the other colours are also obtained from various vegetable and mineral sources. The colours are rendered adhesive and consistent by being worked with gelatinous size. For machine-printing the colour is more or less liquid, so as not to impede the motion of the machine; but in block-printing the colour is worked up almost to a glue.

There are various machines for printing four, six, or twelve colours. The pattern is impressed by a method similar to that employed in calico printing, viz., by a series of rollers placed round a drum, each roller having its own colour-box, sieves, &c.; the chief difference is, that in paper-staining body colours are impressed from the surface of the rollers, whereas in calico printing the rollers are engraved. On leaving the machine, the paper passes into a flue heated to about 200° Fahr., where it is dried and finished. The rate of production is about 42 yards a minute; consequently each machine will produce about 210 pieces of 12 yards every hour. The finished paper is reeled upon large drums situated in a room above.

As a general rule, it appears that the paper-staining trade is not a particularly unhealthy one, although some of the processes are more or less injurious. The emerald-green colour, into the composition of which arsenic largely enters, is not dangerous when proper precautions are taken. These are—that the best quality should be used (the best emerald green is said to be much finer, softer to the touch, and less granular than the ordinary Scheele's green); that it should be perfectly mixed with the size; and that special attention be paid to cleanliness. As the danger arising from the use of emerald-green is generally guarded against, comparatively little injury is done by it. The effects of the brushing process, when done by machinery, are said to be of a more serious character.* In this process a quantity of French chalk or china clay is dusted as a powder over the paper, in order to enable the brushes to move easily over the coloured surface. When the machine is put in motion the powder is raised so as to fill the brushing-room with a cloud of dust, which, finding its way into the throat and nostrils, creates a choking sensation and after a time leads to a greater or less amount of illness.

Stencilling has been mentioned in connection with the early production of paper-hangings; but it has also been applied directly on the wall so as to supply the place of paper-hanging entirely, and where there is any fear of damp it is undoubtedly better than paper. The method of stencilling has been explained in the chapter on PAINTING, &c., and we need not therefore repeat it here. It is a valuable aid to the decorator in the production of panelled or other work on plaster, laying in the outlines truly and rapidly, and leaving the artistic finishing only to be executed by hand, as we have stated in the former chapter.

The French paper-hanging manufacturers have brought much more art into the production of paper-hangings than we or any other nation; not only elaborate compositions of panel work with magnificent bouquets of flowers, scrolls, and ornaments of all kinds, but landscapes and even elaborate figure compositions may have been seen at any of the international exhibitions. The skill exhibited is undoubtedly great, the colours brilliant, and the workmanship true and sound; but, as in the reproduction of the works of the great painters, portraits and figure compositions, in coloured wools, or silk, as in the tapestry of the Gobelins, so in these highly artistic paper-hangings, which our neighbours fitly call *papiers peints*, we cannot but consider that there is a great misapplication of talent. For fragile productions they are far too expensive, and they never can attain the rank of works of art. They are used with effect in such places as the saloons of theatres, where the paper supplies the whole furniture, but *papiers peints* in many brilliant colours, however well harmonized, can never be in place where furniture, dresses, and works of true art have to be considered. Beautiful as are these productions as examples of manufacture, they are objectionable on the ground of good taste.

When the same skilful artists and manufacturers exert themselves in a legitimate manner, their productions are unrivalled for taste and skill; a first-class drawing-room paper in a properly low key by any of the best Paris manufacturers is a charming production. Some few specimens will be found among our illustrations.

* Children's Employment Commission. First Report, p. lxxi. 1863.

But we need not go abroad for good paper-hangings; since the revival of Mediæval Art amongst us—in fact, we may say since the general revival of Art, which had fallen into a terribly low condition half a century since in most countries, but especially in our own—we have acquired some sound ideas about ornamentation and colouring, and the windows of every tasteful producer or dealer contain a profusion of truly simple, artistic paper-hangings, unobtrusive as regards ornament and exquisite in colouring, and, in addition, at moderate prices. In fact, those who have any taste may make all their walls elegant at a very moderate cost.

Papers made to imitate Sienna and other marbles, or woods, and some other kinds, are varnished after being hung; the following is given as a good composition for such varnish:—Four pounds of gum dammar, or white resin, dissolved in a gallon of turpentine; it must be laid on sparingly and evenly with a large brush, and it dries quickly.

CHINESE PAPERS.

THE Chinese, and their neighbours the Japanese, make immense use of paper—they probably invented it; they certainly first made papier-mâché, and no one probably but themselves ever thought of making paper shoe-soles; which, however, are admirably adapted to the purpose, being thick, light, and impermeable. Lastly, to the Chinese is due the introduction of printed paper-hangings. As to the tinted and other ornamental papers that they use, the varieties are endless.

Originally the Chinese used strips of bamboo, which were heavy, or of silk, which were dear; but in the year 153 A.D. one Tsaï-lun produced paper from the bark of trees, hemp, rags, old fishing-nets, &c., and for this a temple was erected to his memory. At present many materials are used in the production of paper, but especially the young shoots of the bamboo, which are planted thickly for the purpose, and then thinned out: the other principal materials are the bark of the paper-mulberry, straw, rattan, hemp, sea-weed, waste silk cocoons. The so-called rice-paper appears to be made from the inner bark of the paper-mulberry.

Tinted and decorated papers are in great request for visiting-cards, lanterns, windows, papering walls, fans, and hundreds of other objects. The colours are mixed with alum or size, and the designs in many cases are most complicated, and consequently these papers are high-priced: the Chinese use red and white lead, cinnabar, vermilion, and other usual colours; but they use also many kinds of flowers and leaves, such as the flowers of the *Sophora Japonica*, which are roasted to produce a fine red colour; and the flowers of the *Carthamus*, and mallow. Rice and oleaginous peas, the *Mimosa* seeds, and other substances are used for sizing, as are certain vegetable sirups mixed with alum.

The Chinese have little glass, and what they have is bad, and paper, made from cotton, is the usual substitute; but it is prepared in a particular manner:—It is damped, then submitted to the action of steam, and is afterwards covered with a mixture of oils of *Sterculia tomentosa* and hemp seed, with white-lead and shelled castor-oil seed. The paper is then wound round a wooden roller, covered with another sheet, and well beaten with mallets, so as to thoroughly amalgamate the oils with the paper. This paper is very strong, but it is dear. For covering umbrellas and parasols a similar process is employed, croton oil and flower being added to the oils named above: this paper supports the effects of sun and rain for a considerable time, but it is heavy and thick; a finer sort is made with the mulberry-bark paper. Often paper is made in such large sheets that it requires two or three persons to lift one without tearing. The paper is dressed with solution of alum, to lay any hairs, &c. The decoration is often executed with great artistic ability, and the Chinese are supposed to have been a thousand years in advance of us in the art.

In Japan, says M. Campion, already quoted, paper is often made without moulds, the pulp being spread on a hot porous stone by means of a brush. It appears that bark, nettles, sea-weed, straw, and other vegetable matters have been made up into paper by the Japanese for some eighteen hundred years. Wood seems to be almost the only thing they have not utilised in that way. As to the decoration of paper, they must have been a thousand years in advance of us.

The consumption of paper in China for useful and decorative purposes must be enormous; lanterns, fans, and hand-screens must consume an immense amount—to say nothing of papier-mâché goods, shoe-soles, windows, and complimentary address cards ten feet long and four or five wide, such as have been shown in this country.

No. 6.—TEXTILE MATERIALS, SPINNING, ETC.



HE industries which work up fibres of various sorts into tissues—the textile manufactures, as they are called—are deeply interesting, from the fact that everybody has an interest more or less in clothing; that the materials are derived from the animal and vegetable and, in a small degree, from the mineral kingdom; that these fibres are sought for and brought from all parts of the world; that the manufactures in question employ an immense number of persons—men, women, and children—in this and other countries; and, lastly, that woven fabrics offer an admirable field for the operations of the dyer, the calico-printer, the embroiderer, and the designer in all branches, to say nothing of that beautiful mechanical arrangement, the Jacquard loom, by means of which the simplest sprig or the most complicated design appears to grow from the mere action of the machine, but which is nothing more, in fact, than a mechanical reproduction of the work of the artist's pencil—the action of this admirable contrivance will be explained in its proper place.

The animal world supplies the spinner and the weaver with silk, sheep's wool, the hair of many animals, including the camel, the Angora and other goats, the alpaca, llama, vicuna, and the horse.

From the vegetable kingdom are obtained, in the first place, cotton, which gives motion to more than thirty millions of spindles, and employment to half-a-million of men, women, and children in our own country alone, and which is largely manufactured in every country in Europe, in India, China, Japan, and the United States. It seems almost incredible, but it is no less true, that such an amazing quantity of this beautiful vegetable down should be produced, that the annual imports into this country should have reached during the past three years the enormous quantity of 620,000 tons annually, of which quantity nearly nine-tenths are converted into yarn, calico, muslin and other fabrics, by the hands of our own countrymen and countrywomen. To those unaccustomed to deal with enormous numbers and large quantities it is very difficult to convey a clear idea upon such matters; but, in order to do so as far as possible, we may say that the exports of cotton yarn, thread, and fabrics has ranged, during the last three years, from sixty-eight to more than seventy-four and a half millions sterling per annum in value.

The other textile trades show large totals; thus the exports of woollens and woollen yarns and fabrics has ranged in the same period from twenty-three to twenty-nine millions sterling; and those of the linen trade from nine to eleven millions sterling per annum; but these two totals, large as they are, only amount together to about half that of the cotton exports.

Besides cotton the vegetable fibres employed in textile manufactures are principally flax, hemp, and jute. There are several varieties of flax grown in Europe, besides New Zealand flax, the stalks of a plant called *Phormium tenax* by botanists. In like manner there is a fibre called Manilla hemp, which is obtained from the leaves of the *Musa textilis*, quite a different plant from ordinary hemp, which is known as *Cannabis sativa*. Jute is derived from the *Corchorus capsularis*. China grass, which is the fibre of a kind of nettle, rhea or ramie, and wild pineapple fibre, complete the list.

Flax was the fibre used by the ancient Egyptians: the mummy-cloths are all of fine linen; the cotton-plant from time immemorial furnished the Indians with their raw material, growing wild in abundance. Silk, there is little doubt, was first used in China, where the spinning and weaving had been carried to great perfection before the Western world knew the name of silk; in the time of the Emperor Aurelian it is said to have been sold in the market at Rome for its weight in gold. The early fabrics of the rest of the world were made from the wool of the sheep, first found in small quantities clinging to the wild plants by which the animals had passed, then plucked out from their bodies by handfuls, and finally taken off in a mass by means of shears.

Many other materials are used by the weaver, and amongst the most important is gold, which in Mediæval times was used to an immense extent, as it is now in India and all Eastern countries. The famous cloth of gold, still manufactured and worn in England down to the time of Queen Mary, if not later, was composed of a warp of linen, crimson, scarlet, or green, with a woof of actual gold, rolled very thin and cut into narrow strips. This cloth of gold presented a superb appearance. The Indian gauzes represent it nowadays admirably. Before wire-drawing was practised as it is at present, very thin gold strips were rolled into wire, or rather tubes, perhaps drawn through a hole in a piece of metal, or the gold was carefully wound round a flaxen thread, so that the edges of the metal overlapped and completely concealed the flax; then came actually drawn gold wire; then silver wire with a thin coating of gold, such as is now used in the production of gold lace; silver, copper, and probably alloyed metal were also used in the same manner as gold. In addition to these applications, gold and the other metals were frequently used in the form of metallic loops, standing up on the surface as ornaments fastened on at intervals, and even in the form of beaten leaf, which was made to adhere in patterns on the surface.

The preceding lines will give an idea of the progress in the application of the various fibres, &c.; but we have not the space, nor does it fall within our plan, to go further into the past history of textile manufacture; the subject is most interesting, and is treated in many works; but the student, in commencing the study, will find an excellent guide in the handbook on "Textile Fabrics," by Dr. D. Rock, published at South Kensington and other museums. The collection of specimens of textile fabrics, ancient and modern, European and Asiatic, at South Kensington, is magnificent. Dr. Rock says that "there is none anywhere so rich or complete," and he adds, "before it was purchased for public use, painters were glad to refer to any scanty collection in private hands, or to old pictures or illuminated manuscripts, or engravings. But now artists may see pieces of the actual stuffs represented in the pictures, say of the National Gallery. For example, in Orcagna's 'Coronation of the Blessed Virgin,' the blue silk diapered in gold, with flowers and birds, hung as a background; our Lord's white tunic diapered in gold, with foliage; the mantle of his mother, made of the same stuff; St. Stephen's dalmatic of green sarcenet, diapered with golden foliage, are Sicilian in design, and copied from the rich silks which came, in the middle of the fourteenth century, from the looms at Palermo. While standing before Jacopo di Casentino's 'St. John,' our eye is drawn to the orfrays on that Evangelist's chasuble, embroidered after the Tuscan style, with barbed quatrefoils, shutting in the busts of the Apostles. Isotta da Ramini, in her portrait by Pietro della Francesca, wears a gown made of velvet and gold, like the cut velvets at South Kensington. So again, instead of copying patterns taken from the rich cloth of gold worn by St. Lawrence in Francia's picture, or from the mantle of the Doge in that by Carpaccio, or from the foot-cloths on the steps in the pictures by Melozzo da Forbi, the artist may find for his authorities in the same collection existing specimens of contemporary and similar fabrics. Decorators also may be equally benefited by the patterns and examples of old wall-hangings and tapestry. From early times up to the middle of the sixteenth century, our cathedrals and parish churches, our castles and manorial-houses, in short, the dwellings of the wealthy everywhere, used to be ornamented with wall-paintings, done not in 'fresco,' but in 'secco'—that is, distemper; and upon high festivals the walls of churches and palaces were hung with tapestry and needlework."

Before quitting the subject of the raw materials of textile fabrics, we must mention some peculiar examples. The natural fibrous rock asbestos, or *amianthus*, which is proof against fire, has been used both by ancients and moderns in the production of fireproof fabrics—for lamp-wicks in ancient temples, and by the Greenlanders of the present day. A similar material has been found in the slag of certain furnaces, blown into fibres. A more unpromising material for textile purposes than glass could hardly be conceived, yet spun glass has been used for furniture and other fabrics with success, the fineness of the colours and the brilliancy of the material having a remarkable effect. The glass is spun from a round stick of it, one end of which is kept in the flame of a blow-pipe or gas jet, and the glass fibre, if it may be so called, is wound off on a reel. We are not aware that this spun glass is much used now; but another form has appeared under the name of glass wool, of which a scientific journal says:—

"Glass wool has received a new application in the laboratories of Austria with great success, the glass being drawn so fine that it may be compared to the fibres of silk, wool, or cotton. The process by which it is manufactured is not well known, and is kept a secret as much as possible by the two firms in Bohemia that provide the market with it. It is, however, said to be made by winding fine threads of nearly melted glass upon rapidly rotating heated cylinders. When seen in a mass, it looks like cotton; its fibres are more easily snapped by tensile strain than by bending, and it

has not the appearance of a mineral substance. As it resists the action of nearly all chemical substances, it admits of being employed in the laboratories for the filtering of solutions, and is cleaned again after each operation by merely letting pure water run through. If an insoluble compound is to be calcined on the filter on which it was collected, it will be obtained quite clean, save a small glass button representing the molten fibres. Unalterable brushes are also made of the same material."

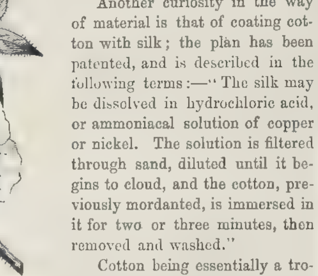


Fig. 1.—Herbaceous Cotton.

Another curiosity in the way of material is that of coating cotton with silk; the plan has been patented, and is described in the following terms:—"The silk may be dissolved in hydrochloric acid, or ammoniacal solution of copper or nickel. The solution is filtered through sand, diluted until it begins to cloud, and the cotton, previously mordanted, is immersed in it for two or three minutes, then removed and washed."

Cotton being essentially a tropical plant, is a stranger to us here at home: an excellent collection of various varieties was to be seen at South Kensington in blossom during the time of the International Exhibition of 1872; but few comparatively of our readers doubtless saw this collection, so we append the following description and illustrations of the fibre which has so vast an interest for this country. "The cotton plant (*Gossypium herbaceum*), which thus flourishes in that country, and in other warm climates, as India, China, &c., is a member of the order Malvaceæ, which contains our common mallow; nor is the plant much unlike the mallow, as our illustration will show. The same herbaceous character, the same structure of the blossom, which in some varieties is purplish, like the mallow, is in others of a pale yellow colour. But there is a very different appearance of the seed-vessel, inasmuch as from the surface of the seed-coat in the cotton-plant there springs up a thick growth of vegetable hairs, or filaments of considerable length, filling the seed-pod and at length bursting it, and exhibiting a ball of snowy-white or yellowish down, consisting of three locks, one for each cell, enclosing and firmly adhering to the seeds, which resemble grapes in size and shape.

Fig. 2.—Tree Cotton.

"There are many varieties of gossypium yielding cotton fit for the manufacturer, and these have been divided into herbaceous, shrub, and tree cotton; the herbaceous being the most valuable. The above description refers to it. The crop is described as a very beautiful one when the pods are progressively opening, the fine dark green of the leaf contrasting with the brilliant white of the cotton suspended from the pods, and floating to and fro at the bidding of the wind. This crop is annual; but shrub cotton, though annual in some cool climates, in others lasts two or three years, and in some cases from six to ten. The shrub is about the size of our currant-bush, and in the hottest countries it becomes perennial, and furnishes two crops in a year. Tree cotton is so called because it often attains a height of from twelve to twenty feet. But it must be carefully distinguished from the cotton-trees of the West Indies and of the American forests. These are prodigious trees, of quite another family (*Bombax*) with buttresses projecting from their huge trunks, and more remarkable for their noble aspect than for any useful purpose to which they can be applied. Many of them bear indeed clusters of a woolly substance enveloping the seeds and resembling true cotton; but there does not exist the same adhesion between the hairs, and the cotton of the bombax cannot therefore be manufactured.

"The true cotton plants are cultivated on a light sandy soil, and in situations where other plants rarely flourish, namely, in the vicinity of the sea, and in what is generally considered very bad land. The saline breezes evidently favour its growth, and the American *sea-island* cotton, which is cultivated on the low sandy islands from Charlestown to Savannah, has long been celebrated for its long fibre and its strong and silky texture. The cultivators of Georgia and the neighbouring States grow three varieties of herbaceous cotton; the first, from its yellow colour called *nankin* cotton, the second *green-seed* cotton, the third *sea-island* cotton. The first two grow in the midland and upland districts; hence a fine white variety is known as *upland cotton*, or, from a method of cleaning it, *bowed Georgia cotton*. There are also other technical names in use in the trade."

There are more than ten distinct species of the cotton plant, varying from the herbaceous plant which is an annual, and which is the chief source of our supply, to the tree-cotton plant, of which we have spoken in a preceding paragraph. It grows in all hot climates; but we obtain our largest supply from the United States. In 1876, the imports were, in round numbers, as follows:—

	Cwts.
United States	8,389,000
Brazil	476,000
Egypt	1,767,000
British India	2,470,000
Other countries	243,000
Total	13,345,000

Or, in other words, more than six hundred and sixty thousand tons.*

The cotton itself is a down, which surrounds the seeds to which it adheres firmly, long in some species of the plant and short in others, and distinguished in the trade as *long-stapled* and *short-stapled*, like wool. The first operation that has to be performed upon the cotton is the removal of these seeds, and this is called *ginning*. It is effected by the natives in India with a very simple machine called a *churka*, consisting of two rollers, one being smaller than the other, which allow the cotton to pass between them, but keep back the seed. A considerable number of native *churkas* were shown at the International Exhibition of 1872, together with English and other machines based upon them, and a series of those employed in producing the yarn, namely, combing and carding machines; drawing, slubbing, and roving or jack frames; self-acting mules; and also power and hand looms, and a number of subsidiary machines and apparatus—a succinct illustration of the machinery of the trade, of which a short report was made under the direction of the Council of the Society of Arts.

It is not our business to enter minutely into the preliminary preparation of fibres. The operations consist first of cleaning, secondly of spinning, and thirdly of doubling or producing yarn containing two or more threads; but all classes of fibres require somewhat different treatment. Silk is wound off with little trouble, the cocoon swimming on the top of warm water to dissolve the gummy matter. Wool requires much washing, with the addition of cleansing and bleaching materials to remove the grease, and has to be worked with oil when being spun. Cotton, as already stated, has to be cleared of the seeds; and lastly, hemp and flax, jute, and other vegetable fibres have to be retted, that is to say, set in water till the skins are loosened and can be removed without much difficulty, and then steeped in alkaline and other solutions to get rid of gummy and other extraneous matters and to bleach the fibre. Such fibres are spun wet. The next operation is that of combing, or carding, by which the fibres are laid in proper order and formed into a continuous riband or sliver: this is performed in two or more successive operations, the machinery employed being modified to suit the various kinds of fibre.

No. 7.—WEAVING.



HE general principles of weaving are the same in all cases, whether we speak of the Indian loom, which has been in use we know not how many centuries, or of the great power-loom, which with its Jacquard machinery produces splendid fabrics with a rapidity that the poor Hindoo weaver could never have conceived.

In a piece of woven cloth two distinct sets of yarns or threads are to be distinguished; these traverse the *web* in different directions, at right angles to each other. The threads which form the length of the web are called the warp-threads, or simply the *warp*. The thread which runs across the cloth is called the *weft* or *woof*, and may be regarded as one unbroken thread, passed alternately over and under each thread of the warp, until it arrives at the outside one, when, passing round and under that, it returns and repeats the process. This constitutes what is called *plain weaving*.

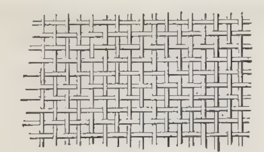


Fig. 1.

Fig. 1 represents the appearance of a piece of plain cloth seen through a microscope: the alternate intersections of the threads are shown in the lower figure.

In *twill* or *tweel* (from the French *touaille*), which comprises an extensive variety of woven fabrics, such as *satin*, *bombazine*, *kerseymere*, the threads of the warp and woof do not cross each other alternately, but only the third, fourth, fifth, sixth, &c., cross each other. Fig. 2 is an enlarged representation of a piece of twilled cloth, by which it will be seen, in this specimen, that the same thread of weft is *flushed*, or separated from the warp, while

Fig. 2.

passing over 3 threads, and is held down while passing under the fourth. In twilled fabrics, the points where the threads of the warp cross each other form diagonal lines, parallel to each other, across the face of the cloth, the degree of obliquity varying with the number of warp threads flushed. In the coarsest or *blanket-twill*, every third thread is crossed. In finer fabrics, the threads intersect each other at intervals of 4, 5, 6, 7, or 8 threads; in some silk stuffs, as in *full satin twill*, there is an interval of 15 threads. In weaving twills, the loom is mounted in a peculiar manner. In plain weaving, the warp threads are passed through two healds, one heald raising every other thread of the warp, in order to admit the shuttle; but in twilled cloth, there is a number of healds equal to the number of threads contained in the interval between two intersections of the warp and weft. Thus, when every third thread is to be interwoven, three leaves are required; if every sixth thread, six leaves, and so on; hence twills are distinguished by the number of leaves required in weaving them, as a *three-leaf twill*, a *four-leaf twill*, and so on. Twills are frequently used by the silk-weaver for the display of colour, and also for the sake of strength, thickness, and durability. In fabrics where the threads cross each other at distant intervals, there are fewer deviations from the right line, and, consequently, less liability to chafe and to wear. By this method, also, a larger quantity of materials can be collected into the same space than in plain weaving, and this of course gives greater durability.

Pile-weaving.—In addition to the usual warp and weft threads, a third thread is introduced in the course of the weaving, and is thrown into loops by being woven over wires of the breadth of the cloth. Sometimes these wires are simply drawn out, and the loops left standing; but in other cases they are cut out, by passing a sharp knife along a groove in their upper surface. In this way a nap or pile is formed, as in the various kinds of velvet, velveteen, fustian, carpets, &c. See Fig. 3.



Fig. 3.

Figure-weaving consists in ornamenting the cloth with figures, flowers, and other devices, for which purpose the warp is divided among a number of healds, which can be lowered at pleasure by separate treadles, while threads of different colours may be concealed or brought up to the face, or made to change places, according to a prescribed order. In figure-weaving, the *Jacquard apparatus* is used.

Gauze-weaving.—The essential feature of this style of weaving is, that between every two casts of the shuttle, the warp threads are made to cross each other, so that the weft threads, represented by black dots in Fig. 4, are separated from each other, and a light transparent texture produced.



Fig. 4.

First we must deal with plain weaving. As already mentioned, the threads which proceed in the direction of the length are called the *warp;* also the *caine* (from the French *la chaine*, the chain), and *organzine*. The threads which run in the direction of the width are called the *weft*, the *woof*, the *shoot*, or the *tram*. Plain weaving, where the weft threads pass alternately over and under those of the warp, is performed at a *loom*, of which the essential parts are—1st, an arrangement for stretching the warp; 2nd, a contrivance for raising every alternate thread, or half the threads of the warp, and depressing the other half, so as to open a space or *shed* for the shuttle which carries the weft; 3rd, a contrivance for striking each weft thread as close as possible up to the one previously thrown.

The frame of the loom consists of four upright posts, connected by cross beams at the top and bottom. At one end is the *beam* or *yarn roll*, B, Fig. 5, on which the warp threads are wound, and at the other end is the

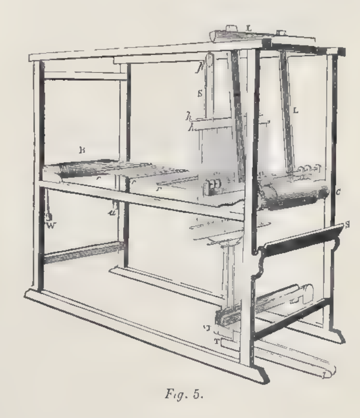


Fig. 5.

cloth-beam, C, on which the cloth is wound as it is finished. In turning round the beam C, fresh portions of the warp are wound off from B; and in order to keep the yarn threads extended, weights, W *w*, are hung by cords to the warp-beam, or a large stone may be slung over it. The extended threads of the warp are prevented from becoming entangled by flat rods, *r r*, placed between the alternate threads. The *healds* or *heddles*, *h h*, by which the threads of the warp are alternately raised or depressed, consist of a number of twines, with loops in the middle through which the warp threads are

drawn. Wire healds have recently been introduced. The two healds are united by a cord s, passing over a pulley *p* (collectively called the *harness*), so that by lowering one heald, the other rises. The warp threads are also passed through the *dents* or teeth of a *reed*, set in a movable swing-frame L L, called the *lathe*, *lay*, or *batten*, shown separately in Fig. 6; the last term referring to its action in batting or beating home the weft. The bottom of this frame is furnished with a sort of shelf, called the *shuttle-race*, along which is thrown the *shuttle*, two forms of which are shown in Figs. 7, 8. The shuttle is a small boat-shaped piece of wood, sometimes moving on wheels, and hollowed in the middle for containing the cop of yarn which forms the weft. A small hole at the side of the shuttle allows the weft yarn to run out with the motion of the shuttle. The shuttle may be thrown by hand, or by means of the *fly*. By the latter method the two ends of the shuttle-race are closed so as to form two troughs, shown separately in Fig. 9, in which two pieces of wood, called *pickers* or *peckers*, are made to move along wires, as

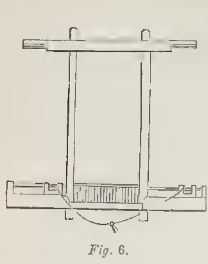
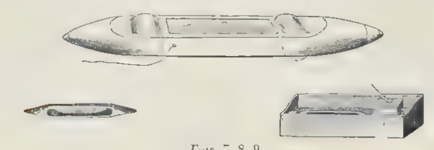


Fig. 6.



Figs. 7, 8, 9.

shown in Fig. 6. A string from each picker is attached to a handle, which the weaver holds in his right hand; and it is thus easy for him, by means of a smart jerk, to project the shuttle along the shuttle-race from right to left, or from left to right. The weaver occupies the seat s, Fig. 5, and pressing with one foot on the treadle T′, he lowers one of the healds, the effect of which is to lower all the alternate threads of the warp passing through the loops; the other heald will of course be simultaneously raised, thus forming a shed for the passage of the shuttle. The shuttle is now thrown across the opening thus formed, by which means a thread of weft is stretched across the web, and this is driven close up to the web by means of the batten, which the driver guides with his left hand. The weaver raises his foot from the treadle T′, and presses down with the other foot the treadle T,—the effect of which is to depress the alternate threads which before were raised, and to raise those which were before depressed. The shuttle is again thrown, whereby another thread of weft is drawn across the web; this is driven home by means of the batten; the treadle T′ is again depressed, and thus the work proceeds with great rapidity. When a few inches of cloth are woven, they are wound on the cloth-beam C by turning a handle at the side, a ratchet-wheel preventing the beam from slipping; but as the weaver must always have a certain length of woven cloth before him, not wound upon the cloth-beam, this would tend to contract in breadth by the contraction of the warp, were it not prevented by some contrivance. For this purpose two pieces of hard wood called *temples*, Fig. 10, are used. Their ends are furnished with sharp points,

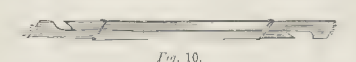


Fig. 10.

which pierce the edge or selvage of the cloth on each side, and thus keep it distended by adjusting the two pieces of wood as shown in the figure.

The warp and weft, or woof, may or may not be of the same yarn, for fabrics are made of all kinds of yarns; but there is this essential difference between them, that the warp threads are harder, that is to say, more twisted than those of the weft. The warp threads have to be laid out parallel to each other by the warping mill, then wound in the same condition on the beam, dressed and sized to give them strength to resist breakage in weaving, and finally comes the tiresome operation known as "drawing-in." When the warp has been regularly wound on the warp beam, every yarn requires to be drawn through the corresponding eye or loop of the healds. This is called drawing-in. For this purpose the yarn-beam is suspended by its ends, so as to allow the warp to hang down in perpendicular threads: the healds are also hung up near the warp ends. The weaver, seated in front of the healds, with an assistant on the other side, picks up every thread in order, and delivers it so that the person on the opposite side may draw it through by means of a small hook. The order in which the threads are to be taken is indicated by the leas-rods, every thread crossing the one next to it. When the warp has been passed through the eyes of the heald, it is drawn through the reed, two threads being passed through each reed-split. The leas-rods being in their proper places, the first thread passes over the first rod, and under the second; the second thread under the first, and over the second, and so on alternately; by which contrivance each thread is kept distinct, and, should it break in the loom, its place can easily be found. A third rod divides the warp into *splitfulls*, two threads passing alternately over and under it. As the work proceeds, small portions of the warp are knotted together; and the drawing-in being finished, the yarn threads are knotted to strings attached to the cloth-beam ready for stretching in the loom. The dents of the reed must be very regular and even, or the warp threads are likely to break, and the texture of the woven fabric liable to irregularity. The number of dents in a reed of a given length, or, as the weaver terms it, the *number* or *set of the reed*, determines the fineness of the cloth, two threads passing through each dent. The set of the reed varies in different places. Thus, a 60-*reed* cloth at Blackburn does not indicate the same degree of fineness as a 60-*reed* cloth at Stockport; but the method of computation at Stockport is the more simple, the fineness being estimated according to the number of warp threads in an inch. A Stockport 60-*reed* cloth contains 60 warp threads in an inch; a Blackburn, a Bolton, and a Scotch 40-*reed* all vary in fineness with the set of the reed.

The loom was formerly worked by the feet acting on two treadles, which lifted alternately the proper threads by means of the healds described above, while the shuttle was thrown to and fro each time by the weaver. To the present moment such looms are used for the finest productions. For plain weaving the case is very different; here the power-loom holds supreme sway: a powerful steam-engine does the work of the weaver, and women and girls watch over, generally, two looms each, stop the loom when a thread breaks, replace the latter, and set the loom in action again. The first sight of a weaving-shed, with hundreds of strongly-built iron power-looms working at their utmost speed, creating such a din that it is scarcely possible to make any one hear a word you say, unless spoken into his ear, produces an extraordinary effect on the visitor; while thousands upon thousands earn their bread day by day amongst them, and doubtless regard them with most uninterested eyes.

The power-loom is the creature of the nineteenth century, and British-born. In 1787 Dr. Cartwright patented a power-loom which he had been working at for some years, and established a power weaving-mill at Doncaster; but the undertaking caused a heavy loss, and so was abandoned. In 1791 the first power-loom was set up in Manchester; Glasgow saw it seven years later; many sheds have now four, five, and some even eight hundred looms going at once. In 1861 there were just upon *four hundred thousand* looms driven by steam in the United Kingdom; and at the same time, we may add, there were more than *thirty millions* of spindles going, to supply yarn for these and other looms. To complete this marvellous account, we may add that the consumption of cotton alone amounted to nearly *seven hundred millions* of pounds per annum, and gave employment to nearly half a million of men, women, and children.

The special features of a power-loom are not very difficult to describe, though the machine itself cost an enormous expenditure of time, labour, and money to bring it to the condition—we cannot say perfection yet—which it has reached.

Fig. 11 represents the essential parts of the power-loom, independently of its framing and the parts for communicating motion. The warp W, wound upon the warp-beam W B, passes over a roller R, and is then carried through two healds H H, which form the shed for the passage of the shuttle,

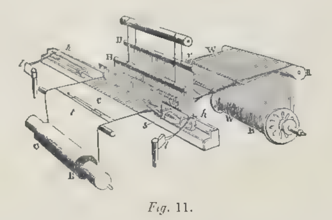


Fig. 11.

which is driven along the shuttle-race by a kind of hammer *h*, worked by a lever *l* moving through a small arc of a circle. The finished cloth C is kept distended by the temples *t*, the portion wound upon the cloth-beam being shown at C, B. Fig. 12 is an enlarged representation of the apparatus for projecting the shuttle through the shed.

In the power-loom there are five distinct actions performed by steam-power:—1st. To raise and depress the alternate threads of the warp. 2nd. To throw the shuttle. 3rd. To drive up each thread of weft with the batten. 4th. To unwind the warp from the warp-beam. 5th. To wind the woven fabric on the cloth-roller. There is also a sixth action frequently introduced, viz. an arrangement for stopping the loom in case a thread

should break, or when the shuttle *traps*, that is, sticks in its course through the threads, or when the cop of yarn contained in the shuttle is run out.

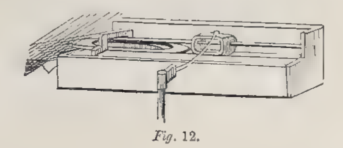


Fig. 12.

We have said that the power-loom is not yet perfected; it works with much friction, and the wear and tear is great—and this is especially so in the case of what is curiously called the "picking motion," which means the arrangement for throwing the shuttle: this is done by two short arms which have a rapid action checked suddenly by two strong straps, so that the shuttle is kept constantly flying to and fro with immense rapidity. Very ingenious attempts have been made to substitute electricity and pneumatic power for these picking arms: an electric loom, by M. Bonelli, was worked in the Exhibition of 1862, and since 1870 Mr. Harrison has shown his ingenious and very simple-looking pneumatic loom; both these created much attention, but we are not aware that they have been adopted yet in factories.

A curious loom was brought from the United States not long since, in which the shuttle was not thrown or propelled at all, but carried: an endless band worked across the loom below the warp, and on this was a little carriage with small smooth wheels; the shuttle had also similar wheels or runners, and these falling within those of the carriage already mentioned, the two worked perfectly together, although the depressed portions of the warp were always between the runners of the shuttle and the carriage. The loom has been at work in this country weaving wire, but we are not informed of the results. Great reports of its success, however, come from the United States.

Power-looms are fitted with Jacquard machines, and produce not only plain fabrics of all kinds, but figured goods in all materials, including lace and carpets: the highest-class goods, such as brocades, fine velvets, and some others are the exceptions.

Hitherto, although we have mentioned the Jacquard apparatus, we have confined ourselves to the description of the loom itself only, whether worked by hand or driven by steam-power. The next step is to give a general idea of pattern or figure-weaving. Before the invention of the Jacquard, the threads of the harness were acted upon by means of other threads, which passed through holes in a board, and had each its wooden handle affixed to the bottom of it; a boy, called a "draw-boy," had a kind of pattern or guide before him, and before each fly of the shuttle, he had to pull down a certain number of these handles, and thus lift the corresponding threads of the harness. The slowness of the operation may be imagined: now the Jacquard acts with absolute certainty, and while the weaver of the most complicated brocade or other fabric has ten or a dozen shuttles with different-coloured silks or wools in them, he has only to press down a treadle and the *card* sets the threads of the warp all precisely as required instantaneously. We will now try to describe the Jacquard apparatus in as brief terms as possible.

Jacquard, the inventor of the apparatus which has caused his name to be so well known, was a straw-hat manufacturer at Lyons. His attention was first directed to the subject of mechanical invention by seeing in a newspaper an offer of a reward for a machine for making nets. He produced the machine, but did not claim the reward. The circumstance becoming known to some persons in authority in Paris, Jacquard was sent for, introduced to Napoleon, and was employed in correcting the defects of a loom belonging to the State, on which large sums of money had been expended. Jacquard stated that he could produce the effects intended to be produced by this loom by far simpler means. He was requested to do so: and, improving on a model of Vaucanson, he produced the apparatus which bears his name. He returned to Lyons with a pension of 1,000 crowns; but his invention was regarded with so much mistrust and jealousy by the weavers, that they attempted to suppress it by violent means. The "Conseil de Prud'hommes," who are appointed to watch over the interests of the Lyonese trade, ordered his machine to be broken up in the public *place*, and, to use the pathetic expression of Jacquard himself, "the iron sold for iron, the wood for wood, and he, its inventor, was delivered over to universal ignominy." Other countries, however, appreciated the invention, and had it in successful operation, rivalling and even surpassing the products of the French loom, before the Lyonese weavers recognised their folly. The Jacquard apparatus soon got into general use in the silk, worsted, and muslin manufacturing districts of France and England.

The apparatus is fixed to the upper part of the loom in a line with the healds, and the warp threads are raised by a number of wires arranged in rows and formed into hooks, *h h*, at the upper extremities, as in Fig. 13. These hooks are supported by bars, *b b*, the ends of which are represented by dots; and the bars are supported by a frame, which is alternately raised and lowered by a lever attached to and acting with the treadle. If all the bars are raised at the same time, all the warp threads

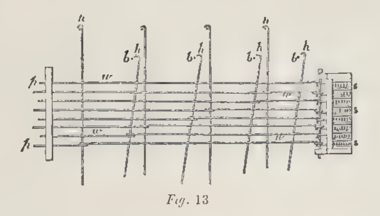


Fig. 13

will be elevated; but if some of the hooks be pushed off some of the bars while the others are allowed to remain on, such warp threads only will be raised as are connected with the engaged hooks. Accordingly, there is a contrivance for disengaging the hooks from the bars, and this is effected by means of horizontal wires, *w w*, furnished with loops in the centre (shown separately in Fig. 14) through which the lifting wires are made to pass. These horizontal wires are kept in position by spiral springs, *s s*, contained in a frame, and the points of the wires, *p p*, protrude from the opposite side.

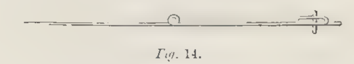


Fig. 14.

Now, it is evident, from an inspection of Fig. 13, that if the points of the wires be pressed by any force, the wires will be driven into the frame, the hooked wires passing through them will be disengaged from the bars, and the warp threads of the disengaged wires will not be elevated. When the pressing force is removed, the elasticity of the springs will drive the needles forward and restore the hooks to the bars. The method of driving back the wires is by means of a revolving bar of wood, Fig. 15, of four or

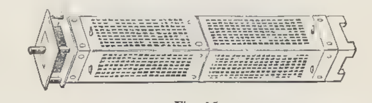


Fig. 15.

more sides, each side being pierced with holes corresponding in number and position with the points of the needles. One of the sides of this bar is brought up against the points of the wires every time either treadle is depressed. If the side of this bar alone were to be opposed to the points of the needles, the latter would simply enter the holes and no effect be produced; but if some of the holes be stopped while others be left open, the wires which touch the stopped holes would evidently be driven back, and the hooks of the vertical wires attached to them be disengaged from the bars; while those which enter the holes would remain undisturbed, and only the warp threads attached to their vertical wires would be raised. This stoppage of some of the holes in each face of the revolving bar is effected by covering it with a card containing holes corresponding with those in the bar, but fewer in number; so that, when the points of the wires come in contact with an unperforated part of the card, they are driven back, but when the points enter the holes of the card, the wires are not moved, and, consequently, the hooks of the vertical wires remain on their bars. By this contrivance the intended pattern is made out. The revolving bar presents a new card to the point of the horizontal wires at every quarter revolution, if the bar be four-sided. The holes in the cards being so arranged as to raise, in succession, those healds which will make out the intended pattern, it is necessary that there should be as many cards as there are threads of weft. Where the pattern is complicated, the number of cards is very considerable. In some of those absurd attempts to represent in one material forms and objects which are easily and naturally delineated in another, such as the portrait of a man woven at the loom instead of being painted at the easel, the number of cards required is great; for example, the modern Lyonese weavers, to atone for the ingratitude of their ancestors to their illustrious countryman, resolved to erect a monument to his memory; and the result was one of those extraordinary specimens of perverted ingenuity, a portrait of Jacquard, woven in silk, representing him in his workshop, surrounded by his implements, and planning the construction of the Jacquard apparatus. For this "Hommage," as it was called, there were 1,000 threads in each square inch, in both warp and weft; 24,000 cards were required for the pattern, each card being large enough to receive 1,050 holes. In the Jacquard apparatus the cards are fastened together by threads, so as to form an endless chain, one complete revolution of which makes out the pattern, which is usually repeated many times in one warp.

The preparation of the cards for the pattern is a special employment, not undertaken by the weaver. The pattern, on an enlarged scale, is first drawn upon squared paper, and is then repeated in a frame containing a number of vertical threads, corresponding with the warp of the fabric; the workman then, with a very long needle, takes up such threads as are intersected by the pattern, inserting a cross-thread under them, and carrying it over all the remaining threads in the same line, repeating the process until he has inserted a sufficient number of threads to make out the pattern. This being done, the threads thus interlaced are attached to a card-punching machine, which resembles in principle the Jacquard apparatus, and is provided with lifting-cords, wires, and needles, connected as in Fig. 13, so that by pulling the lifting-cords, the wires or needles will be protruded. In front of these needles, corresponding with the revolving bar, Fig. 15, is a thick perforated iron or steel plate, each of the perforations containing a movable steel punch, fitting easily into the hole: the protrusion of any of the needles drives the punches which correspond with them into a second similarly perforated iron plate, fitting close to the face of the first. In order that the steel punches may be properly protruded, one end of each warp thread is connected in succession with the separate lifting-cords of the machine; each thread of the weft is then taken by the two ends and drawn upwards, by which means all the warp threads passed under by this weft thread will be raised, and can be collected together in the hand, by pulling them; the lifting-cords to which they are attached will cause the needles to protrude, and these will drive out the cylindrical cutters from the perforations on the fixed plate into the corresponding cavities of the movable plate. A blank card slip is placed upon the latter, which is then removed to a fly-press, and the punches are driven through the card slip. The process is repeated on all the other card slips required for the pattern, the various cards being numbered and attached together in order. The movable plate and the perforated card are represented in Figs. 16, 17. The two outer large black spots at each end of the plate are guide-holes corresponding with those in the cards, and are used for tying the various cards together. The other

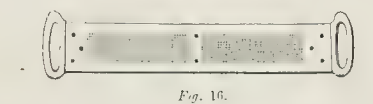


Fig. 16.

large spots, one at each end of the card, fit into the conical projections of the revolving bar, Fig. 15. The set of cards required for the production of a pattern is made up into a bundle, with a numbered label and a portion

Fig. 17.

of the fabric attached to it. In using the chain of cards at the loom, they are arranged in several folds, and are partly supported on a curved board.

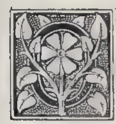
Many modifications of the parts of the Jacquard have been made or suggested; in the case of carpet-weaving, the so-called *cards* are pieces of sheet iron, the wear being excessively heavy; on the other hand, the cost of the cards is so great, that for light work a band of prepared paper has been introduced, which weighs only a tenth of that of the card, and does not cost one-seventh of the price. M. Bonelli's electric loom does away with cards altogether, substituting a pattern drawn on endless bands of tinfoil laid on paper, on which was drawn the pattern in a black composition which was a non-conductor of electricity.

Besides figures, there are other patterns which demand a few words. Uniformity of texture is produced by the warp and the weft threads being of equal fineness, while the texture itself depends on the fineness of the yarn and the set of the reed. Yarns of different degrees of fineness, introduced at intervals into the web, will give two distinct textures, producing a sort of striped pattern which admits of much variety. When the warp threads are of one colour, and the weft of another, a *shot* pattern is produced, the loom being arranged as in plain weaving. In *striped* patterns, the stripes may be arranged by the warper, who introduces at regular intervals the coloured threads required to make the stripe. Variety is also produced by employing yarns of the same colour, but of different degrees of fineness; or by drawing a larger number of warp threads through some of the eyes of the heald than others. Thus, two or more threads may be passed through the same eye of the heald, or three or more healdfuls through the same intervals of the reed; or, with fixed stripes, both methods may be employed. When stripes extend across the cloth they are thrown with the weft, the weaver employing shuttles containing coloured threads, which are used at proper intervals.

Checks are formed by combining the two methods of striping. The warper first produces an alteration of colours in the warp, by inserting coloured threads; and the weaver produces a further alteration by throwing in wefts of different colours from one or more shuttles.

In the preceding chapter we have spoken of the splendid collection of textiles to be found in the South Kensington Museum, which, until a very short time since, was the only museum in this country which offered such opportunities to the weaver, designer, or student; in nearly all the great centres of textile manufacture on the Continent there are not only museums containing raw materials, machinery, and fabrics, but also schools where weaving, dyeing, and other operations are taught by practical men, under the superintendence of professors at once scientific and practical. The first of these establishments is the Conservatoire des Arts et Métiers, of Paris, which contains a number of machines and models, including the original Jacquard, with its predecessor, the work of the famous mechanician Vaucanson; and to which is attached a staff of professors, men of the highest eminence, who lecture constantly on all the arts and sciences on which depend the various manufactures. Besides the museum at South Kensington, and that of Edinburgh, we have in this country scarcely any establishment which gives any aid to the manufacturer, dyer, designer, or student. Yorkshire has now wisely established a College of Science, to which will doubtless be added eventually a collection of specimens and models; and it is a good sign that the council of that establishment commissioned Mr. Beaumont, the instructor in weaving in the college, to visit the technical schools in Belgium, Germany, and France.

No. 8.—TAPESTRY.



OF all objects of Art, tapestry perhaps holds the highest place in the estimation of amateurs, or at any rate divides it with jewellery, enamels, and china. There are many reasons for this: in the first place, Raffaelle and the greatest artists that have yet appeared designed specially for tapestry; secondly, tapestry is intimately connected with chivalry, and is full of historical associations; it decorated the walls of palaces, castles, and grand mansions in remote ages; it speaks generally of times and things which have a romantic interest; many of the most famous examples are of great antiquity; and, lastly, the cost of producing fine tapestry is so enormous that such work can never become common: unfortunately some persons think the last is the highest quality any object can possess.

Tapestry is certainly one of the oldest of Art-manufactures, but it is impossible now to trace its source, partly because of a confusion in terms: all hangings are *tapisseries*, or tapestry, and while the word painted seems often to have been used in old times for figured, there were cloths used as tapestry upon which subjects were painted as on the canvas of a picture. The Egyptians produced tapestry at an early period, for in the book of Proverbs we find "painted tapestry brought from Egypt," but the kind of tapestry is here, of course, doubtful. The palace of the kings of Babylon, we are told by Philostratus, was ornamented with tapestry woven of gold and silver, which recalled the Greek fables of Andromeda, Orpheus, &c. Other Latin authors speak of marvellous specimens of tapestry, for which Nero and other emperors gave enormous sums of money. The Greeks, according to their usual habit, attributed the invention of tapestry to one of their deities, Minerva: Homer speaks of hangings, and represents Helen working tapestry during the siege of Troy. Amongst the Romans, tapestry was in great request, and, like all fashions, was carried to ridiculous excess when the nation was declining.

Tapestry was introduced into France and other countries at an early period in our era, when it was the occupation of the high-born ladies of the land, as it became in our own country; but, as already said, whether true tapestry or embroidery cannot now be ascertained. M. Lacroix, whose charming work on the Arts of the Middle Ages and the Renaissance we have already mentioned, says that no document authorises us to say that the production of tapestry or carpets, in a loom, commenced in France earlier than the ninth century; the documents of that century speak frequently of tapestry.

About the middle of the tenth century a regular factory for the production of tapestry was established in the monastery of St. Florent, at Saumur, and another not very long afterwards at Poitiers. At this period the English had acquired a high reputation for embroidery, or carpet-weaving, as Dudon, the historian of the Dukes of Burgundy, says that fine specimens of such work went by the name of English work, *Ouvrage Anglais*. Much more interesting historical information than we have room for will be found in M. Lacroix's work, in which are some curious coloured and other representations of ancient specimens of tapestry.

The famous so-called "Bayeux tapestry," a copy of which may be seen at South Kensington, it should be mentioned, is not tapestry, but needle-work on canvas.

In the fourteenth century Arras, in Flanders, became celebrated for its tapestry, which went by the name of Arras for a long period. The fine old specimens to be seen in the Louvre and the Museum of the Hôtel Cluny, in Paris, and at Fontainebleau, Versailles, and other places, are principally the work of the people of Arras, of which innumerable fine examples exist. Francis I. set up a royal factory at Fontainebleau, and then tapestry was first made of any great width; formerly it was made narrow, and the pieces fine-drawn together. Henry II. formed one in Paris. Henry IV. installed the famous tapestry manufacturers in the Louvre, and had a number of clever workmen brought from Italy to produce tapestry in gold and silver. Later on three other royal factories were established—one at Beauvais, and the Savonnerie and the Gobelins in Paris. The productions of Beauvais and the Savonnerie were principally—and still are, for although now joined to the Gobelins, they maintain their character—for covering furniture, the subjects being confined to floral and other decoration. In the time of Louis XV. and Louis XVI. the style had become very conventional and the colours vapid; since that time there has been great improvement, and the Beauvais tapestry is in its way perfection. Of the Gobelins tapestry we will not undertake to speak, but translate as literally as possible that which is said in M. Lacroix's work on the subject:—"Since the sixteenth century the tapestry executed at the Savonnerie, the Gobelins, and Beauvais is more perfect as regards the weaving, in so far as it is more regular, and as regards design there is more harmony of colour and better perspective; but, unfortunately, the *naïveté* of the good old time is gone. During and from the time of Louis, under the influence of the school of Le Brun, they affected imitations of Greek and Roman forms, which looked out of place in France. They made fine faces, but insignificant figures. The truth, which was formerly naively set forth, gave place to studied art; the ideal dethroned the natural; and convention, spontaneity; ingenious, pretty, and even beautiful works, but wanting in that which gives life to works of Art, character."

Visitors to Paris may see the work in hand at the Gobelins, and will find some good specimens produced during the late Empire—portraits of artists, in the sumptuous Gallerie d'Apollon, in the Louvre.

In England, as in France, tapestry work was taken up by the religious communities, and the hangings which decorated the churches were principally the work of nuns and monks. Famous examples of tapestry are mentioned by our historians, such as three reredos, made for St. Alban's Abbey, in the reign of Henry I. Chaucer has a *tapiser* amongst his Canterbury pilgrims, showing that tapestry of some kind was not a rarity in his time. In the interesting handbook to the textile fabrics in South Kensington Museum, by Dr. Rock, to whom we are indebted, the following existing specimens of English-made tapestry are mentioned:—A damaged specimen in St. Mary's Hall, Coventry; a reredos for an altar, belonging to the Vintners' Company of London; and a piece in a house in Cornwall. Holland House, Kensington, has some curious specimens of late-Flemish tapestry in the raised style.

The most beautiful existing series of tapestry is that which was made from the famous "cartoons"—so called because drawn on stiff paper—by Raffaelle, which, having been purchased by Charles I., were rolled up, hidden away, and forgotten for a long period. The history of these famous works is curious. They were executed in chalk, and coloured in distemper, by Raffaelle and his pupils for Pope Leo X., in the year 1513. They are about twelve feet high. Of the series of ten, three have been lost; the subjects of these three having been:—"The Stoning of St. Stephen," "The Conversion of St. Paul," and "St. Paul in his Dungeon at Philippi." The designs of the seven, which are now in one of the picture-galleries of the South Kensington Museum, are:—"Christ's Charge to Peter," "The Death of Ananias," "Peter and John healing the Lame Man," "Peter and Barnabas at Lystra," "Elymas the Sorcerer struck blind," "Paul preaching at Athens," "The Miraculous Draught of Fishes." A tapestry worked from the original hangs opposite to the first-named of the above cartoons. These cartoons were discovered by Rubens, lying neglected in the warehouse of the manufacturer at Arras, and the painter advised Charles I. to purchase them for a royal tapestry factory established at Mortlake. After the death of the king, Cromwell bought them for the nation for £300, but they remained hidden from public view until William III. commanded Sir Christopher Wren to build a room specially for them at Hampton Court, where they remained until removed to South Kensington Museum. The Pope is said to have paid Raffaelle 434 gold ducats for these cartoons. The tapestries produced after the cartoons were worked in wool, silk, and gold, and were hung in the Sistine Chapel in the year 1519, the year before the great artist died, and excited the greatest admiration; they are now in the Vatican. They are said to have cost 50,000 gold ducats.

Besides the works at Mortlake, there was a manufactory in Soho, London, and at the latter, in 1758, were produced large tapestries for a room in Northumberland House, Charing Cross, now demolished. The designs for this tapestry were by the painter Zuccarelli. Neither of these factories were successful, and have long ceased to exist.

Before closing this very brief sketch, we should mention that there existed long since in England manufactories for imitative tapestry, the painted cloth already mentioned, and the trade was important enough to be formed into a London guild.

We have said that the two factories in England failed; but they had

not, perhaps, the same aid from the public purse that the royal factories have had, and still enjoy, in France. In the year 1876, the budget of the Minister of Public Instruction contained the following items :—

"For the maintenance and repair of public monuments, 1,100,000 francs; for works of Art and decoration of public edifices, and for purchases for the museums, 915,000 francs; the manufactory of Sèvres, 493,600 francs; that of the Gobelins, 208,000 francs; that of Beauvais, 108,850 francs."

In the section devoted to the Ministry of Commerce and Agriculture, appear the following items :—Conservatoire and schools of Arts et Métiers, 1,408,600 francs; but against this there is a set-off of 397,350 francs for receipts; and the sum of 704,000 francs is set down for the encouragement of manufactures and commerce in various ways.

The Gobelins maintains its reputation and activity: at the International Exhibition in Paris in 1878 were to be seen numerous examples of Gobelins, Beauvais, and Savonnerie work; which were admirably exhibited, together with a choice selection of Sèvres china, in an elegant Renaissance temple occupying the same position in the French half of the grand vestibule as the Prince of Wales's Indian temple occupied on the British side; the collection included two pieces of tapestry—subject, Earth and Water, by Tabrum—for the Hôtel de Ville; the Vainqueur, after Hermann; Silene, a nymph of Diana, after Machard, for the Luxembourg; two panels symbolizing Keramic Art for the Sèvres manufactory; several panels for the decoration of the *glacière*—ice room, or first-class refreshment room—of the Grand Opera House—figures representing wine, fruit, pastry, ices, and other delicacies; there were also some decorative panels in Beauvais work and two enormous Savonnerie carpets. Of the last there is nothing to be said in their favour but that they are solid, well-woven fabrics; as to designs they belong to the worst period of Art, that which may be considered to have ended about half a century ago; the Silene is a wonderful rendering of the life-size, or larger, nude figure in wool, in that sense a *chef d'œuvre;* the other examples of Gobelins work are of various merit, but all exhibit admirable workmanship and splendid colouring; but the Beauvais work deserves unqualified praise. Here the style is perfectly fitted to the kind of work, the designs consisting of flowers and fancy ornamentation admirably composed and as admirably executed: the flowers themselves are perfect studies, and the rose, hibiscus, and other effective kinds are massed, harmonized, and contrasted with great skill.

We have spoken of tapestry works which formerly existed in our own country, and we must not omit to name the Royal Windsor Tapestry Manufactory lately established under the presidency of H.R.H. Prince Leopold. In the dining-room of the pavilion of H.R.H. the Prince of Wales are eight panels, subjects taken from the *Merry Wives of Windsor*, which reflect immense credit on the directors, artists, and workers of this new royal manufactory. With the skill acquired of late years in designing for Art-manufactures, this new factory may be the means of producing valuable examples for the guidance of artists and Art-workmen; at any rate it will help to swell our stock of beautiful objects, and that alone is an important service. It is not to be expected that it will ever attain such importance as the Gobelins and other State manufactories attained in France, for, in the former, costly experiments were made in dyeing, and all the other contributing industries were carried out by eminent scientific men remunerated from the State treasury, at a time when Art-workers were men of small means, working in their almost solitary ateliers as in the old times; whereas in our own country no undertaking seems too gigantic, no experiments too costly, for our Art-manufacturers; many of whom, if they do not possess actual artistic genius—though there are some we could name who do have acquired excellent taste and much Art-knowledge, the effect of which appears in all the decorative industries, whether Keramic, metallic, textile, or other.

Tapestry, it has been said, is neither weaving nor embroidery, but partakes of both; originally, however, it was more like weaving than it is at present. The ancient tapestry loom was like the ordinary loom in form, and this kind was long in use in France and elsewhere, as well as the more modern. The old method is known as *basse lisse*, and the new as *haute lisse*. The word *lisse* really means the harness of a loom, but it is here used for the warp, while the words *basse* and *haute* are used for horizontal and perpendicular: this little explanation may be of use to beginners, as we have seen the terms used as if they meant high and low, or long and short pile. The warp is formed of extremely well-made twine, and the weft of silk, wool, or a mixture of the two—sometimes with gold and other threads interspersed, woven, or rather tied, in by the fingers of the workman. In the 14th and 15th centuries the art of working on the loom, in the early *haute lisse* or high-warp style, was practised in the tapestries of Flanders, and perhaps in those of England. In the *haute lisse*, the frame containing the warp-threads is vertical, and the weaver works standing; in the *basse lisse*, on the contrary, the warp-frame is horizontal, and the weaver sits to his work. In the basse lisse the painting to be copied is placed beneath the threads of the warp; the weaver carefully separates the threads with his fingers, so as to be able to see a portion of his pattern, and then with a shuttle called a *flûte*, containing silk or wool of the required colour, in the other hand, he passes it into the shed formed by depressing the treadles, worked in the usual way. The weft, thus introduced, is driven up to the finished portion of the work by means of a boxwood or ivory comb. In this kind of weaving the face of the work is downwards, so that the weaver cannot examine it until it is removed from the loom, a circumstance which probably led to the disuse of the *basse lisse*. In the *haute lisse* the loom consists of two upright side-pieces, with large rollers placed horizontally between them, the warp being wound on the upper roller, and the finished web on the lower one. The cartoon or pattern sheet is first placed close behind the frame and the principal outlines of the pattern are sketched upon the front of the warp, the threads of which are not so close as to prevent the artist from seeing the design between them. The cartoon is now removed to such a distance from the warp as to allow the weaver to stand in the space between, and he works with his back to the pattern sheet, so that he must turn round when he wishes to inspect it. The side pieces of the frame contain the means for forming a shed in the warp threads for the passage of the weft; a reed or comb, or a large needle, called an *aiguille à presser*, being used to force home the weft. As in the case of the *basse lisse* the artist necessarily works at the back of the fabric, as there the knots must be made, but by walking to the other side of the frame he is able to inspect the work and correct defects at any moment. The progress of the work is terribly slow. A practised hand can only produce about one square yard in twelve months.

No. 9.—CARPETS AND RUGS.

THE origin of carpets is unknown: in cold countries probably sheep-skins were used as mats, in hot countries the skins of lions, tigers, and other animals would be early used for their beauty; in our own country rushes supplied the place even in palaces until a late period. Carpets are said to have been introduced from Spain in the fourteenth century, and they are often mentioned in the fifteenth, but in such a manner as to show that they were then rare luxuries. It is certain, however, that the use of carpets was before common in the East, and it is probable that they were first introduced into Europe, as many, nearly all our artistic manufactures were, through the Crusaders: we may pretty safely date back their introduction to the twelfth century. There exists an inventory in MS. in the Bibliothèque Nationale, at Paris, in which is a long list of tapestry and carpets, which are minutely described as regards their materials and design; these belonged to the king. This same manuscript states that there were carpets called *velus* or velvet, now called in France *moquettes*. English tapestry is also spoken of as already famous. Soon after this period they were produced in Italy, Spain, Flanders, and France. Still for a long time carpets like tapestry were very costly, and were only used by kings and queens, or hung on the walls, laid upon the stone seats, and spread about the floors, on grand occasions.

Turkey, Persia, India, and Tunis for a considerable period supplied Europe with carpets, and their admirable texture, softness, and good taste are still admitted: the Persian carpets, perhaps, are the most remarkable for beauty, and those of Turkey for richness, but they all have this in common, that they were well designed for their intended purpose. The designs are generally simple, conventional, and do not come into contrast with dresses, furniture, and decoration; at the same time the materials are soft and warm to the feet, the colours are durable and harmonious, and in all we see a total absence of apparent projections, such as cornices, scrolls, or anything else which can convey an idea of discomfort or unfitness. Until lately European carpets were false in design and glaring in colour, but now we may be proud not only of the make of our carpets, but also of their design and harmony of colour: there are still, however, enough of the false kind to be seen to show how immense has been the progress in this respect.

There are six chief varieties of carpet in this country, viz. the *Axminster*, the *Venetian*, the *Kidderminster*, the *Scotch*, the *Brussels*, and the *Wilton*. The Kidderminster carpet presents an example of *double-weaving* or *two-ply*, and is produced by incorporating two sets of warp, and two of weft yarns; such are called in America *in-grain* carpets. Scotch carpeting resembles Kidderminster, but it includes a *three-ply* or *triple in-grain*.

The *Eastern loom* consists of two upright pieces of wood fixed at some distance, supporting a roller at the top, which carries the warp or chain, and a second roller about 2 feet from the floor, upon which the finished carpet is wound. The work is done entirely by hand: coloured worsted is tied in, in short lengths, each tie passing across the face of two warp threads, round the back, and has the ends brought up between them. When a row of ties has been completed, a shed is formed in the warp, and the shoot is passed across from right to left and returned, binding the whole together, and is beaten down to a horizontal level by hand-beaters. In the Great Exhibition there was a carpet from Cashmere, made entirely of silk, and containing at least 10,000 ties in every square foot. It was remarkable for the beauty of its texture, and the softness and harmony of its colouring.

The *rug loom* or *Turkey carpet loom* of Europe is similarly constructed. The warp or chain, of strong linen yarn, is mounted on the upper beam, and brought down through headles to the lower beam. The weaver is seated as at the common loom, and having thrown a weft thread once or twice across, he fastens to every thread of the warp, by a peculiar twist, a small bunch of coloured yarn, varying the colour according to the pattern before him. One row being completed, he passes a linen weft through the web, and drives it well up, so that the small bunches or tufts may be held securely. Another row of tufts is then twisted in, according to the pattern. In this way narrow breadths of carpet are produced, which, being placed side by side and joined together, form one large carpet; the surface is then sheared even. *Rugs* are formed by a similiar contrivance. A number of coloured worsted yarns are hung over a bar to the right of the weaver, who, taking the end of one yarn, attaches it to the chain, cuts it off to the proper length, then twists in another, which he severs in the same manner, and in this way forms a row of tufts across the warp; he next passes a shoot or two of weft, and then drives up the weft with considerable force. Young girls are employed in rug-making; their nimble fingers tie in the coloured worsteds with great rapidity, and, from constant practice, they know which particular colour to use at any particular spot, without referring to the pattern sheet.

Venetian carpets are also produced at a common loom. The pattern is formed entirely by the warp, the weft being concealed: the warp consists of a heavy body of worsted, arranged so as to form stripes, which shade off imperceptibly from dark to light. By using shoots of different kinds plaids and checks may be formed, and by a proper arrangement of the headles a twilled or dotted pattern may be produced. *Dutch* carpeting is similar to plain Venetian, but cow-hair is sometimes introduced.

The Kidderminster, or Scotch carpet, has a worsted chain and a woollen shoot, and consists of two distinct webs incorporated into each other, so as to produce the pattern. Each tissue is perfect in itself, so that if one be carefully cut away, the other appears like a coarse baize. Both tissues are woven simultaneously, one or other being brought up to the surface as required to produce the pattern in any particular part. There is always a tendency to the formation of stripes in this species of carpet, since the pattern is produced by one set of coloured stripes crossing another, and much skill is required in the arrangement of these stripes. Full colours are obtained by crossing the warp with similarly coloured weft, and any particular colour can be concealed by sending the threads to the other web. In general the warp is not much varied, variety of colour being produced by the weft. For example, the weaver has often a warp of two colours only, such as white and maroon: across the white he may throw white, drab, fawn, light-green, and yellow, to form a fancy or shaded ground. With the maroon warp he may use two or three different shades of weft consisting of full greens, scarlets, crimsons, blues, and olives. The warp shows very little on the face of the carpet. A two-ply Kidderminster, from the nature of its construction, has a right and a wrong side, the colours being reversed. If, for example, the colours be green and red, the green portions on the one side will be red on the other, and *vice versa*. A Jacquard apparatus is attached to the loom for regulating the pattern, and the weaver has a variety of shuttles, containing wefts of different colours. The pattern-designer in this style must arrange his figures, and dispose of his colours, so as to conform to the restrictions under which the weaver is placed. The three-ply carpet allows of greater variety and brilliancy of colour than the double carpet, while its great thickness and comparative cheapness are great recommendations. It is largely manufactured at Kilmarnock.

A variety of carpet called *British*, or *damask Venetian*, is a kind of mixture of Venetian and Kidderminster. It resembles Kidderminster in the weaving, but in Venetian the warp only is seen, while in Kidderminster the shoot is chiefly at the surface. This variety is also called *French*, or *tapestry carpeting*.

In Brussels carpet there is a linen web, enclosed in worsted yarn of different colours, raised into loops to form the pattern. The structure of this carpet is represented in Fig. 1, in which the small black dots represent the ends of the shoot, and the double waving lines two separate sets of linen warp or chain: between the black dots, or between the upper and under shoot, is the worsted yarn, usually consisting of 5 *ends* of different colours; each end may consist of 1, 2, or 3 threads, according to the quality of the carpet. Supposing there are 2 threads to each end, which is the common number, there will be 10 threads bound into the carpet every time the warp is shed. The pattern is formed by bringing to the surface at any particular spot such of the five coloured yarns as are required, and they are formed into loops by being turned over wires which are represented in the figure by the large black dots. As the coloured threads

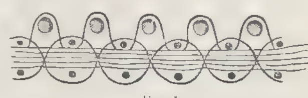


Fig. 1.

are taken up very unequally, they are not wound upon one beam, but are placed separately upon separate bobbins, arranged in frames at the back of the loom, with a small leaden weight or bullet attached to each bobbin, as in Figs. 2, 3, which show a bobbin nearly empty, and one full of yarn, to keep the worsted slightly stretched. The bobbins are mounted in pairs, as shown in Fig. 4, with a wire or *spit*, also called a *benchwire*, passing through them, and resting in grooves upon a frame. Such is the arrangement at Kidderminster. At Wilton, the arrangement is somewhat different, and will be explained by referring to Figs. 5, 6, 7.

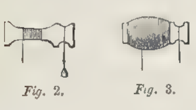


Fig. 2. *Fig. 3.*

The loom itself is represented in Fig. 8. In such a loom there are as many frames as there are colours; the number of bobbins in each frame is regulated by the width of the carpet. The usual width is three-quarters of a yard, in which case there are 260 bobbins to each frame. But if the carpet be a yard wide, the number of bobbins is 344. From each bobbin, the ends are carried through small brass eyes, called *males* or *mails*, attached to fine cords, one eye and one cord for each end. Each cord is passed over a pulley fixed above the loom, and is brought down again by the side of the loom, and is fastened to a stick. For a three-quarter carpet, there are 1,300 of these mails, cords, and pulleys to each loom; the pulleys are arranged in a frame or box at some distance above the mails. It is evident that by pulling the cords as they hang at the side the mails or brass eyes will be raised, and with them the worsted ends which pass through them; but if all the ends are raised simultaneously, no pattern will be formed; an arrangement must therefore be made beforehand, to pull such of the 1,300 cords as will raise the colours required in each particular spot, for which purpose, in the absence of the Jacquard apparatus which is now commonly used, the draw-loom already referred to in a previous section was employed in the following manner. Those cords which will raise to the surface certain yarns required for the pattern are bound together into a *lash*. One lash is necessary for every set or row of colours that has to be drawn to the surface, and the lashes are taken in regular succession until the pattern is complete. The number of these lashes is often large; as many as 320 may be required to make out a pattern a yard long: this being completed, the succession of the lashes is repeated for the repetition of the pattern. The lashes are pulled by an assistant boy or girl, called the *drawer*. Supposing the loom to be at work, the drawer takes the first lash, and gently draws forward the 260 cords, whereby they are separated from the others. He then pulls the lash with considerable force, and thus raises such of the 1,300 ends as are required for the pattern; inserting with the other hand, under the raised ends, a light wooden board, or *sword*, about 3 feet long, and 5 inches wide; it is set up on edge, so as to retain the raised ends about 5 inches above the surface. The drawer then lets go the lash, and the weaver inserts into the *bosom*, or opening formed by the sword, a round wire through the whole width; the drawer takes away the sword, and the weaver depresses one of the treadles, whereby one of the linen warps is raised above the surface; while the other warp, together with all the remaining worsted ends, is depressed. The shuttle with a linen shoot is then thrown in, the weaver depresses the other treadle, whereby the worsted and the warp before depressed are now raised, and then throws in a second or under shoot, forcing the materials closely together with a heavy batten. This completes the weaving of one wire; a second lash is then drawn, and the work proceeds as before. When a number of wires have been thus woven in, they are drawn out one at a time with a hook inserted into a bow at the end of each wire; but the last five or six wires must be left in, or the worsted loops would be drawn down flat, and show the linen web. Sixty wires form what is called a *set*.

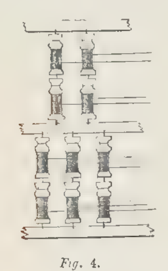


Fig. 4.

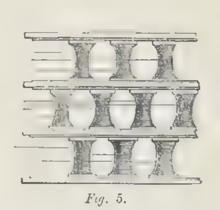


Fig. 5.

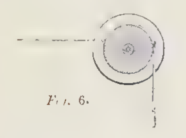


Fig. 6.

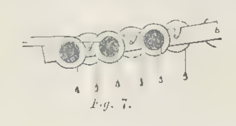


Fig. 7.

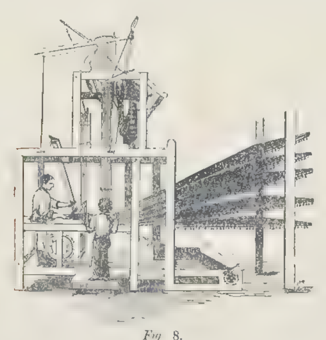


Fig. 8.

The Wilton carpet, called *moquette* by the French, differs from the Brussels in the form of the wire, and in the method of removing it from the loops. The wire used for the Wilton carpet has a groove in the upper surface, and the edge of a sharp knife being drawn along this groove, the wire is thus liberated. The worsted loops thus cut form a pile or velvet. By increasing the size of the wire, the Wilton carpet can be increased in thickness or quality. The quality of Brussels and Wilton is measured by the number of wires included in the inch, usually 9 for Brussels, and 10 for Wilton; but whatever number is adopted, great uniformity must be observed, or the pattern would not match when the breadths were joined together at the sides. As a guide to the weaver, a bell is made to ring when 64, 80, or 90 lashes have been woven; he then ascertains by a measure whether the required number of lashes measures a quarter of a yard; if too short, he repeats the last lash, or omits it if too long. The length of a piece of Wilton carpet is 36 yards. After the weaving, the nap or pile is sheared after the manner of broadcloth, the action of the knife being assisted by circular brushes.

It will be seen, from the foregoing details, that in the production of the Brussels carpet only one of the five sets of coloured yarns appears on the surface at any particular spot, the other four being concealed in the web. Mr. Whytock has effected a great economy in this respect. It occurred to him that if for the five coloured yarns he could substitute one yarn dyed of the requisite colour at different places, he would be able to get rid of all the apparatus for producing the pattern, the web being worked with only one body like a simple velvet. His arrangement for dyeing the warp-threads is as follows:—The yarn is arranged in regular coils on the surface of a large hollow drum, Fig. 9, on a horizontal axis; the surface of the drum is covered with blanket, and on this is oil-cloth, to keep the blanket clean. The dye is applied to the yarn by means of rollers; each roller is about 9 inches in diameter, and ½ inch wide, and works in its own colour-trough, supported by a low carriage. To apply the colour to the yarn, the carriage is moved across the cylinder, when the roller is made to press by means of springs against the coils of the yarn, thus imparting to them a coloured streak without any pattern, a portion of each coil being stained to an extent equal to the printing surface of the edge of the roller. When the yarn is unwound, the coloured marks thus produced will be at equal distances along the length of the yarn. One impression being made, the cylinder is turned round through a space equal to the breadth of the impression left by the roller; and then, if the pattern require a change of colour, another roller charged with another colour is applied across the yarns so as to make a second streak by the side of the first. By a repetition of this process, the cylinder of yarn is completely covered with streaks, the colours being in the order required by the pattern in the woven fabric. The yarns are next removed from the cylinder, together with the oil-cloth covering, upon which they are kept extended until the colours are dry. The yarns are then made up into hanks, and the colours fixed by steaming. They are next washed in water to remove the gum or paste with which the colours are mixed up, and after being dried they are wound upon bobbins for warping. In the meantime another set of yarns is wound upon the cylinder, and dyed by a similar process, and in this way the whole of the warp yarns

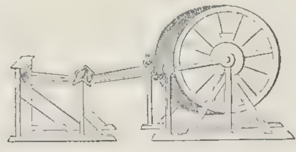


Fig. 9.

are prepared. The party-coloured threads are next arranged side by side to form the warp. As each yarn forms several coils round the cylinder, the order in which the colours succeed each other will be repeated at intervals along a length of each yarn equal to the circumference of the cylinder. The succession of colours is determined by a design paper containing the pattern, ruled with squares, the lines being numbered along the top and down the length, and containing the entire figure of the pattern, so that, whatever number of squares the design paper occupies, the circumference of the cylinder must be divided into a like number of equal parts, or a multiple thereof, such as the double and the triple. In applying the colour to the yarns, a narrow black line is impressed across them as a common starting-place for all, and this black mark is to be repeated at the points where the repetition of the pattern begins. All the yarns being properly adjusted, the black marks will range in a straight line across the breadths of the warp, and the pattern will be correctly made out by the party-colours of the yarn. To keep the colours in their places, a clamp, Fig. 10, is applied across the warp, which is shifted across as the weaving proceeds. The weaving is conducted after the manner of plain weaving, without the assistance of the complicated apparatus required in figure-weaving. When the weaver has woven one length of the pattern, he moves the clamp to the next black line. If the black marks which form it do not range together, some of the warp threads are gently pulled and adjusted, and the clamp is screwed fast as before. If the warp be wound upon a beam before it is placed upon a loom, the clamp is not required in weaving, but only in beaming; but when the warp proceeds at once from the bobbin to the loom, the clamp is used.

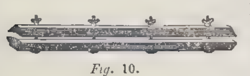


Fig. 10.

Tapestry and carpets formed a valuable division of the International Exhibition held at South Kensington in 1871, and the report on that class by Mr. Pollen contains some remarks on carpet designs which we recommend to the reader's attention.

"We may divide the Oriental carpets into three classes—the Turkish, Persian, and Indian. Very fine carpets are made in the Northern States of Africa (in parts of Algeria), but the quantity is inconsiderable, and we do not find them often in the English market. The dyes of these Algerian carpets are bright, specially certain delicate yellows, owing to the fineness of their wools, which take and retain an exceedingly pure primrose stain. The Turkey carpets are exported in large quantities from Smyrna, and of these the greater number are made at Oujak, in the province of Aidin. They are made by hand, each tuft of wool being knotted on the thread of the warp with the small wooden needles or shuttles containing the material of the pattern. The smaller rugs are made at the village of Koula, in the neighbourhood. The designs of the large carpets are rude and simple. They descend from a remote antiquity. The general distribution is a great central pattern disposed diamond-wise, large masses of pattern, similar to the centre, in the four corners, and sometimes, where the carpet is long, similar masses on the two sides. The intervening space is generally starred or spotted with a simple pattern. Red or green are the general ground colours, with blue, yellow, and black. Several lines of border run round the whole. The green and red are counterchanged one on the other. The Turks represent no living animals, and in the coarse material and thick tufts used for these carpets, two or three foils or leaves are the nearest resemblance to a flower. Perhaps a mosaic of broken zigzags and spots, forming, when united, a great flower with broken outline something like the columbine, is the nearest recognisable design that can be assigned to them. The large Turkey carpets, however, are always rich and harmonious in colour. The disposition of the pattern mainly aims at this result. Even when not exactly collected in the described way, the pattern continues isolated, and leaves portions of ground unoccupied. White is rarely seen in old-fashioned Turkey carpets. We notice, however, white borders in some examples, and this seems a departure from the grave tone of the old patterns. The Koulah rugs are totally different in colour and in effect, though the designs remain much as those of the large Turkey carpets. In these small carpets, or rugs, the colours are more brilliant; white is used often, and narrow borders are numerous.

"The Persian carpets are of similar make to those of Turkey, but the designs are different, and so is the colouring. In the larger Persian carpets we find the pattern, which is conventional, more broken than the Turkish, and evenly distributed, so as to give an effect of blending all the colours together. Deep blue, pink, and apple-green are predominant, the ground being generally dark blue. White is freely used in small lines of separation between the colours. The borders are gay, and the main line or division of the border is usually occupied by a sort of flower with a centre and petals. If we compare Persian wares, such as the painted wood-work of Cashmere (thoroughly Persian), and the inkstands, boxes, and picture-frames that are imported from Persia, we see at once a finer and more pictorial notion of design than any we shall find in Turkish art. The Persians, a sect of Mahomedans differing from the Turks, permit the designing of living creatures; and both in painted ware, shawls, and in direct portraiture we see depicted animals, hunting scenes, and the moon-faced and stag-eyed beauties of the Persian harem. Hence, in all their painting and colouring there is a more vivid appreciation of nature and a more refined and varied system of colouring. Light ultramarine blue, tender varieties of grey, broken by delicate gilded patterns, &c., are favourite hues in Persian colouring. We shall recognise this variety and luxuriance by a glance at the Persian textiles. . . . . Persian rugs or carpets are occasionally sent over, consisting of a plain ground of rich golden yellow, broken by one conventional cypress tree with birds or animals or a flower or two, equally conventional, and borders round. We meet with these patterns on white, or on scarlet grounds as well. . . . The number of Persian carpets large enough to form the actual carpeting of our rooms is small. Most of those imported are used as hearth-rugs. They are largely imitated in France, and the imitations are imported in great numbers into this country. Though the designs are copied from Persian and Turkish patterns, the effect is dull and heavy when compared to the genuine rugs. They are sold at a lower price.

"By far the most beautiful and characteristic carpets exhibited this year are those from Masulipatam and other parts of India. The designs of these are various. Of Indian colouring the full Indian red, broken by flowers or conventional leaves, in which orange predominates, forms a leading feature. A cool, low blue, a green of similar gravity of hue, and soft, creamy white, complete the palette of the Indian designer of these fabrics. We cannot help seeing that some of our carpet-dealers have had changes effected in this old Indian system; that some white in borders has been actually *bleached*, and that one or two garish combinations have been introduced. The colours have been intensified and made flatly uniform, instead of broken and slightly varying as the masses of red and other colours are left by the native weavers. . . . In all such cases we cannot but regret losses of the exquisite harmony of the native arrangements of form and colour.

"Besides these woven woollen carpets, India produces velvet carpets embroidered with gold from Benares and Moorshedabad. . . . These rich fabrics are of fine velvet, embroidered with bullion gold. They belong properly to another class of fabrics. . . . We may, however, include among carpets those woven of silk throughout. The Maharajah Goulab Singh contributed such a carpet to the Great Exhibition of 1851—a magnificent manufacture of pure silk, nearly an inch thick in the pile, showing to perfection the dyes and the harmonious arrangement of the native artists. In every square foot there were said to be contained ten thousand ties or knots of silk. . . . .

"The older of our modern regular fabrics of carpets in Europe are those of Aubusson and Beauvais. These, as to designs, are more or less in the character of tapestry.

"We cannot but see with satisfaction how the Oriental taste in this matter is creeping into our modern carpet designs. A glance at the Axminster and other velvet or cut carpet designs in the long porcelain gallery this year will show how the Oriental designs, altered in such ways as European imitators must be expected to alter them, have obtained a sway unknown twenty years since. Messrs. Jackson and Graham, among the enterprising furnishers of our more sumptuous modern houses, have a number of designs worked for themselves. Most of these originate with Mr. Owen Jones, whose admiration and advocacy of Oriental decoration have had so wide an influence. No modern architect has been so influenced by Oriental feeling in his interior designs. His carpet designs of this kind are the most successful exhibited."

In the Persian department of the South Kensington Museum will be found an interesting collection of carpets, rugs, &c., of various kinds and periods; amongst the least known are what are called *numud*, which are a kind of felt carpet or rug, used for the sides and ends of rooms; they are made of felt, doubled, and ornamented with designs which are not stamped, as in our table-covers, but inlaid. Another peculiar specimen is an oval mat of brown velvet embroidered with flowers in coloured silks and gold and silver threads. These, of course, are not carpets proper, which in Persia are called *kali*. Of these there are many specimens of various kinds: *saraudaz*, of white cotton, with flowers worked in silks; *sejjiadeh*, made of black velvet, for kneeling on at prayers, decorated in gold, silver, and silk; woollen carpets from Kerman, Kashan, Yezd, Ispahan, Turcomania, and Kurdistan; with prayer and other carpets of silk, satin, cotton, and other materials, quilted, embroidered, and decorated in various ways, patchwork, &c., but they are all apparently modern. There is a curious carpet, however, which is dated early in the eighteenth century, formed of dark blue velvet, with red velvet border, and embroidered with gold, silver, and silk, with gold fringe. Mediæval carpets are now very rare; but there are two examples in the South Kensington Museum, one of the fourteenth, the other of the sixteenth century, of Spanish make. Messrs. Vincent Robinson & Co. had a beautiful Oriental example three hundred years old in the Paris Exhibition of 1878. The Indian Museum is rich in carpets.

No. 10.—LACE-MAKING AND EMBROIDERY.


INE old lace ranks with fine old china and fine old wine; and, apart from all considerations of age and curiosity, lace is a beautiful thing of itself, and still more so when united with silk, satin, velvet, or even cloth, black or coloured: the artistic eye has not overlooked lace, and the pictures of the time of the Stuarts, by Vandyke, Sir Godfrey Kneller, and Sir Peter Lely, show the kind of lace worn at that period; and it is the same in respect to the pictures of other countries. The origin of lace is unknown: it was worn by ladies of Greece and Rome, and was introduced at an early period into Venice and northern Italy, and it seems to have appeared in France and England about the time of Queen Elizabeth.

Until the last few years of the past century, all lace and net was hand-made: since that time the number of machines invented for the lace manufacture is extraordinary. The kinds of lace are numerous, and the modes of working various; but these have this in common, that their groundwork, whether produced previously or at the same time as the lace, is some kind of net. This network being the simplest portion of the work, supplies the first illustration: a reference to the three figures of net (Figs. 1, 2, and 3), given further on, will show how net is formed, whether by hand or by machinery. In making net by hand pins are used to form the meshes, and the threads are simply twisted together, as is well shown in the last of the three figures just referred to. The object aimed at in ordinary net is to make the meshes as nearly as possible perfectly hexagonal.

Pillow or *bobbin lace*, the original manufacture, was usually made of thread or silk woven into the net with hexagonal or octagonal meshes. It was afterwards ornamented with a thicker thread called gimp, so interwoven with the meshes as to form flowers and curved designs. This kind of lace was made on a hard, stuffed pillow or cushion, covered with parchment, on which the pattern was drawn. Each thread was wound upon a bobbin, a small round piece of wood, with a deep groove in the upper part for retaining the thread. To form the meshes, pins were stuck into the cushion, and the threads woven or twisted round them. The pattern on the parchment indicated the spots for the insertion of the pins, and also showed the place for the gimp, which was interwoven with the fine threads of the fabric. The work was begun at the upper part of the cushion by tying the threads together in pairs, each pair being attached to a pin. Bobbins were allowed to hang down by their threads on different sides of the cushion, but at the commencement of the work they were all arranged on one side, and were brought to the front side, two pairs at a time, and twisted together. The woman, holding one pair of bobbins in each hand, twisted them over each other three times, so that the threads of each pair became twisted together or round each other, so as to form the sides of the mesh. The adjacent bobbins of each pair were next interchanged, in order to cross these threads over one another to form the bottom of the next. Supposing the four bobbins to be marked *a*, *b*, *c*, *d*: *a* is twisted round *b*, and *c* round *d*; these in order to cross *b* and *c* are interchanged, so that *a* and *c*, and *b* and *d*, come together; the next time the twisting is performed these pairs of thread will be combined together. As the meshes or half meshes are made, they are secured by pins to prevent the threads from returning. The four bobbins *a*, *b*, *c*, *d*, being done with for the present, are put on one side of the cushion; the two next pairs are then brought forward, twisted, and crossed in the same way. These operations are repeated until a row of meshes is formed sufficient for the breadth of the intended piece of lace; the bobbins are then worked over again to form another row. As many as from 48 to 60 bobbins are required for every inch of breadth, and only one mesh is made at a time. A piece of lace one inch wide, with 50 threads per inch, will have 25 meshes in the breadth, or 625 meshes in each square inch of length, or 22,000 meshes in the yard, while the cost of such a piece is seldom more than 1*s.* 8*d.*

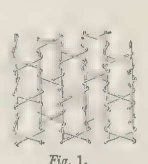
Such is the principle of all lace-making, but the varieties are numerous, as are the modes of working with bobbins, needles, hooks, or spindles.

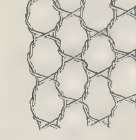
The most celebrated laces have been enumerated as follows:—1. *Brussels*, the most valuable, and of which there are two kinds: *Brussels ground*, having a hexagon mesh, formed by plaiting and twisting four threads of flax to a perpendicular line of mesh; and *Brussels wire ground*, made of silk, of which the meshes are partly straight and partly arched. In both cases the pattern is worked separately, and set on by the needle. 2. *Mechlin*; a hexagon mesh, formed of three flax threads twisted or plaited to a perpendicular line or pillar. The pattern is worked in the net. 3. *Valenciennes*, an irregular hexagon, formed of two threads, partly twisted and plaited at the top of the mesh. The pattern is worked in the net. 4. *Lisle*, a diamond mesh formed of two threads plaited to a pillar. 5. *Alençon*, called *blond*; hexagon of two threads, twisted, similar to Buckingham lace, and is considered the most inferior of any made on the cushion. 6. *Alençon point*, formed of two threads to a pillar, with octagon and square meshes alternately.

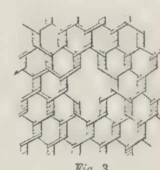
Mrs. Bury Palliser, in her report on Lace, &c., at the Paris Exhibition of 1867, which we recommend to our readers, says that the laces of Alençon and Brussels are produced by such complicated processes, each managed by a different hand, that it formerly took about eighteen lacemakers to complete a piece; but that the number has been rather diminished. Again, says the same authority, a specimen of Valenciennes lace, of which the whole work, ground and pattern, are made at once with the same thread, was shown in progress with twelve hundred bobbins attached. Amongst the famous laces, the Chantilly is extinct; it is now represented by the lace of Bayeux, in Normandy: this, as well as the black Bayeux shawls and flounces, is made in short lengths, which are attached together with great skill. This is now the most important of the lace manufactures of France. A dress, consisting of two flounces and trimmings of Alençon point, was exhibited, which had occupied forty women seven years, and the price of which was £3,400.

For a considerable time the mode of producing the old elaborate point lace was lost, but it has been rediscovered, and the *point Colbert* now made in France is, according to Mrs. Palliser, the same as the ancient "rose," or "Venice point." The flowers and figures in this lace are in high relief. In Brussels lace the flowers are made on a pillow and then sewn on the net: this is called *appliqué* work, or in English "application." Valenciennes lace is not now made in that town, but in East and West Flanders, Ypres being the most celebrated make: it is remarkably beautiful both in fabric and design. The Honiton lace, and that made in Bedfordshire, Buckinghamshire, and Limerick, are very beautiful fabrics, scarcely surpassed, and the patterns, which used to be heavy and inartistic, have of late years been so improved that they now take rank amongst the best varieties of lace. We need not dwell more upon this portion of the subject, but recommend our readers to peruse the report already referred to, as well as that of Mrs. Henry Reeve, on the lace shown at the International Exhibition of 1871. Amongst our illustrations will be found the designs of many kinds of lace, British and foreign, and fine examples of old lace may be examined at the South Kensington Museum.

Net is said to have been first made by machinery by a Nottingham stocking weaver named Hammond, in 1768, and his apparatus, called the pin machine, is still used in France for producing *tulle*. From that time an immense number of new machines and improvements were invented, till in 1809 Mr. Heathcoat succeeded in producing bobbin-net by machinery, and in 1816 this was effected by steam-power. The complication of a bobbin-net machine is so great that even those who have been all their life accustomed to other machinery find it most difficult to understand the various movements at first sight; but by taking the several parts separately it is not very difficult to describe. A piece of lace (such as that represented in Fig. 1) will be found, on examination, to consist of a series of nearly parallel warp-threads proceeding in one direction, while the weft


Fig. 1.


Fig. 2.


Fig. 3.

twists once round each warp-thread until it reaches the outer one, when it makes two turns, and then proceeds towards the other border in a reverse direction; by means of this double twist and the return of the weft-threads the selvage is formed. The effect of the twisting and interlacing of the

threads is to form the straight and parallel warp-threads with the weft into regular six-sided meshes, as in Figs. 2 and 3, which represent on an enlarged scale the production of the fabric by the union of three sets of threads—one set consisting of the warp-threads proceeding from the top downwards, in a waving line; the second set runs towards the right, and third to the left; the second and third being weft-threads which cross each other obliquely in the centre, between each two meshes throughout the series; in fact, one set of weft-threads draws the warp-threads to the right, and the other to the left. After the warp-threads have been laced twelve times by the weft-threads, the latter is moved sideways through one interval of the warp-threads. Lace-making thus differs from weaving in this, that the threads of the warp are not alternately raised or depressed for the passage of the weft, but are shifted sideways to the next pair, to which they become united by means of the weft-threads, which also work in pairs, each of them entwining two individual threads at once.

The thread used in the lace-frame is wound upon the roller for the warp, and upon small bobbins peculiarly formed for the weft. In warping, the threads are first wound upon a reel, which extends the whole length of the thread-beam, and from which they are transferred to the latter, called also the roller; portions of the reel and of the thread-beam are represented in Fig. 4. The bobbins for the weft-threads are shown in front and



Fig. 4. *Fig. 5.*

in section in Fig. 5. Each bobbin is formed of two thin brass discs with a hole in the middle of each, riveted together, so as to leave a circular groove between them for the reception of the thread. In the centre is a square hole for receiving a square spindle or rod, for preventing the bobbins from turning round during the process of winding the thread. From 100 to 200 bobbins are thus spitted, and the thread is conducted from a drum through the slits of a brass plate, corresponding in number with that of the bobbins to be filled. On turning round the spindle which contains the bobbins, the drum revolves and delivers its thread; the surface of the table over which the train of thread passes is painted black, so that the winder immediately detects the breaking of a thread. As many as 1,200 bobbins may be required for one machine, and in order that the same quantity of thread, usually about 100 yards for each bobbin, may be wound upon each spitful, a hand moving round a dial-plate is made to indicate the quantity wound.

Each bobbin is next inserted in a small iron frame, called the bobbin-carriage, Fig. 6, where it is shown in the front and side section, the hole H in the carriage receiving the bobbin, the grooved borders of which fit the narrow edge *e e* of the hole, the spring preventing the bobbin from falling out, but allowing it to turn round and give off its thread when

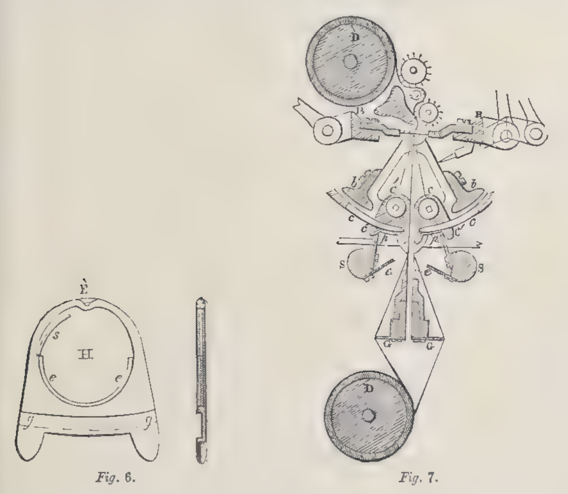


Fig. 6. *Fig. 7.*

gently pulled. The thread is conducted through the eye, E, at the top of the carriage.

The working parts of the lace-frame are shown in the vertical section Fig. 7: D (below) is the thread-beam containing the warp, and at the top of the frame is a similar roller D for receiving the finished work. The warp threads are stretched in vertical lines between these two rollers. G G are guide-bars extending the whole length of the machine, with slits in their edges, through which the warp-threads are conducted in two rows, one on each side, to the eyes *e e* of needles, one of which is shown separately in Fig. 8. Each guide-bar, which contains a range of these needles, equal to one-half the number of threads in the warp, has a *shagging* or slightly shifting motion to the right or to the left, to allow the bobbin-threads to pass on the right or on the left of the warp as many times as is necessary to produce the twist. The number of bobbins, with their carriages, is equal to the number of the weft-threads, and as these have to pass through the narrow intervals of the warp-threads, they are arranged in a double line in two rows, as at c c′, Fig. 7, on each side of the warp-

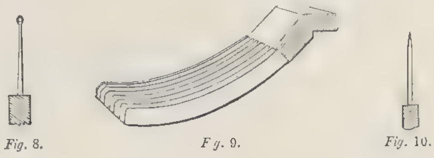


Fig. 8. *Fig. 9.* *Fig. 10.*

threads. The bobbins are supported between the teeth of a sort of comb *c c′*, a portion of which is shown separately in Fig. 9. The bobbin carriages are each furnished with a groove for the reception of the teeth of the comb. There is one comb on each side of the warp, and the free ends of the teeth in the opposite combs stand so near to each other as to leave a space only just sufficient for the proper motions of the warp-threads between them; hence the carriages, in passing across through the intervals of the warp, reach the back bolts before they have entirely quitted the front ones. The carriages are driven alternately from one comb to another by two bars *b b*, and when one of the lines of carriages is pushed nearly across the intervals of the warp, the foremost of their projecting catches *c′ c′*, Fig. 7, is laid hold of by a plate *p* attached to a horizontal shaft S, which pushes it quite through. The beam to which the combs are attached admits of being shifted a little sideways, either to the right or to the left; by which motion the relative position of the opposite combs is changed by one interval or tooth, so as to transfer the carriages to the next adjoining teeth. By this means the whole series of carriages makes a succession of side steps, to the right in one comb and to the left in the other, so as to perform a species of countermarch, in the course of which they are made to cross each other, and then again to twist round about the vertical warp-threads, and thus to form the meshes of the net. After the bobbins have moved several times round about the warp-threads, and entwined their threads with them, a point bar B B, Fig. 7, containing a row of pointed needles, one of which is shown separately in Fig. 10, falls between the warp and weft threads, and carries the interlacements of the latter up to form a new line of holes or meshes in the lace. Here it remains, while the other point bar makes a similar movement to produce a second line of meshes. Thus the whole working of the machine is a constant repetition of twisting, crossing, and taking up the meshes on the point bar.

The beauty of bobbin-net lace depends on the quality of the threads, and on the equal size and hexagonal shape of the meshes. The nearer the warp-threads are together, the smaller are the meshes and the finer is the lace. The number of warp-threads in a piece one yard wide may vary from 700 to 1,200. The fineness of the lace, or as it is called the *gauge* or *points*, depends on the number of slits or openings in the combs, and consequently the number of bobbins in an inch of the double tier. Thus gauge nine-points means nine openings in one inch of the comb. The length of work, counted perpendicularly, which contains 240 holes or meshes, is called a *rack*. Well-made lace has the meshes slightly elongated in the direction of the selvage. A circular bolt machine produces about 360 racks per week, working eighteen hours per day. The narrow quillings used for cap borders are worked in the same machine in many breadths at once. They are all united together by a set of threads, which are afterwards drawn out, and thus the quillings become so many distinct pieces.

The next step was the application of the Jacquard apparatus to the warp-machine, which was effected by Draper in 1839, and allowed of the production of sprigs, spots, flowers, &c., in lace work, which had hitherto always been effected by hand; the machinery was gradually modified until the inventors succeeded in producing almost every kind of lace, and, amongst other productions, those wonderfully elaborate curtains for which Nottingham enjoys well-deserved celebrity, and which are now produced of any required size. Some excellent examples are given in our illustrations.

When flowers and other decorations are produced in machine-made lace, the yarn used to produce them, which is called gimp, passes behind the plain net and cements the flowers together; this connecting gimp is afterwards cut out by children with scissors. A much superior class of goods is produced by what are called "pusher machines:" these form the net with the pattern,

which is afterwards completed by hand with the thicker thread called gimp; by this compound process scarfs, shawls, and lace of great beauty are produced, as there is no limit to the amount and quality of the hand-finishing. We give several beautiful examples of this kind of lace amongst our illustrations.

Very recently a most important improvement in lace machinery has been made by Mr. Edward Cope, of Nottingham, who has really succeeded in producing Art-lace by mechanical means; some of the patterns we have seen, designed by Dr. Cornelius Dresser, are in all respects admirable. This was quite an unlooked-for step in the art of lace manufacture.

Embroidery.—We have spoken of lace and embroidery, and therefore it will be well to say a few words by way of definition. Generally, embroidery is needle-work, but we have already seen that lace is also sometimes produced by the needle; again, lace is sometimes made *with* the net which forms its groundwork, and sometimes *on* net produced previously. Embroidery is always made on canvas or some other tissue, or on leather with the aid of a needle, a "caub," a hook, or a piercer. It must be one of the oldest means of decoration, for it is found amongst nearly savage tribes, in rude forms, and it has been practised by every nation which has left any records behind it. Embroidery is done with every kind of thread and yarn, gold, silver, and copper wire, and even straw, and is frequently studded with spangles, stars, and other small objects in metal, beads of all kinds, and often with pearls and gems.

Ordinary embroidery is generally distinguished as white and coloured. France, Switzerland, Saxony, Scotland, and Ireland, are the principal producers of white embroidery in Europe; and the chief kinds made are *plumatis*, or satin stitch, tambour, crochet, *point d'armes*, chain stitch, and needlework. Specimens are to be seen in the shops of every town.

Coloured embroidery is produced principally in Paris, Lyons, Milan, and Vienna, chiefly for ecclesiastical purposes. Magnificent work of this kind is also produced in Russia, Greece, and Roumania.

Embroidery, as practised in England, comprehends: 1. Embroidery *on the stamp*, where the figures are raised, and rounded by means of cotton parchment beneath. 2. *Low* embroidery, where the gold and silver lie low, stitched with silk of the same colour. 3. *Guimped* embroidery, which is executed either in gold or silver. 4. Embroidery on both sides of the stuff. 5. *Plain* embroidery, which is flat and even, without cords, spangles, or other ornaments.

Several kinds of embroidering frame are in use, but one of the most easy to manage is made with a system of iron hooks fixed upon the cross pieces of the frame, and serving to stretch the canvas on the two opposite sides. This sort of frame is now but little used, on account of the price of its construction. The working embroiderers prefer the screw or the lath frames, which are sold at a cheaper rate, and admit of more easy adjustment. But in the lath-frame the material is often stretched too much or too little, and thus it is inferior to the screw-frame, in which the stuff can be stretched little or much, according to the wish of the worker. Most of the frames in use have the disadvantage of obliging the embroiderer to sew the two sides of the canvas upon the galloon nailed upon the two rollers, then to roll up the canvas, and fix it to the sides by means of packthread, which is liable to distend it too much, and tear it. Improved frames have been introduced, in which the canvas is secured by blunt points attached to the sides, and covered with a wooden bar, cut half-round, and having along its length a slit or groove of a width corresponding with the points. The sides of the frame are secured and the canvas properly stretched by means of screws. One of these improved frames is shown in the accompanying engraving, Fig. 11. Those who desire to know more about the history and practice of embroidery should consult Mrs. Stone's book on "The Art of Needle-work from the Earliest Ages," edited by the Countess of Wilton.

Embroidery is now produced by machinery; the manner in which this has been accomplished is most ingenious.

In 1834, M. Heilmann of Mulhausen exhibited an embroidering machine which enabled a female to embroider a design with 80 to 140 needles as accurately, and nearly as expeditiously, as she formerly could with one.

The principle of this ingenious machine is as follows:—The needles with which the ornamental work is performed are furnished with a point at each end, and the eye in the middle. These needles are held by pincers in a frame, and the piece of stuff which is to be embroidered being stretched in a vertical position, the carriage containing the needles is wheeled up to it; all the needles pierce it at once, and on passing through a certain distance, are seized on the other side by the pincers of a second frame. On drawing this frame away from the fabric, it is evident that the needles must be completely drawn through, together with the threads inserted in them; and on sending the second frame in its turn up to the cloth, the needles will be passed through in an opposite direction, and be clipped and drawn through by the first frame. Between these motions of the two frames backwards and forwards, the frame in which the cloth is suspended is moved by an attendant in a regulated order by means of a lever attached to a pantograph, the attendant going regularly over the points of a pattern drawn on a large scale at the side; the stuff is slightly shifted at each motion, and the pattern is repeated thereon, on a reduced scale, by the passage of the needles.

Fig. 11.

No. 11.—FLOOR-CLOTHS AND TABLE-COVERS.



IN our own country, where the practice common in most others of laying the floors of rooms with hard wood capable of brilliant polish, and which is often arranged in elegant designs, is not followed, the necessity for some kind of floor covering is a matter of consideration and expense. All our rooms are carpeted, or partially carpeted; but there are halls, passages, stairs, and lobbies to be covered also, or we have the poor-looking deal-boards making a wretched appearance, unless they be stained and varnished or polished. This staining is very satisfactory when well managed, but where the boards of the floor have gaping spaces between them, or other irregularities, the effect is greatly marred. Marble, stone, encaustic tiles, and mosaic are adopted in halls and passages of fine houses, but they are all costly, though really economical, and floor-cloth is almost the only covering in use in the great majority of houses, and is a peculiarly British manufacture.

Floor-cloth is a cloth, or canvas, painted on both sides, the under side being plain, the upper side ornamented with a pattern. It is essential that

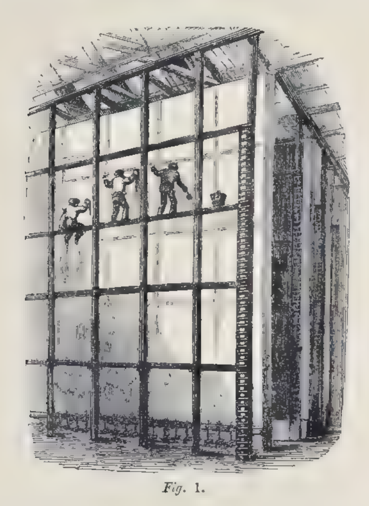


Fig. 1.

it should be without seam, and it is woven in pieces from 18 to 24 feet in width, on looms adapted to this great width, and at which two men (one on each side) are employed in throwing the shuttle backwards and forwards. The length of the warp often exceeds 100 yards. Dundee is the seat of

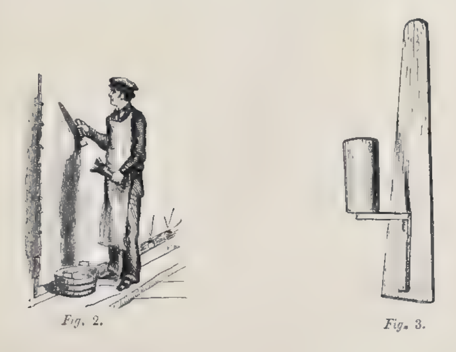


Fig. 2. *Fig.* 3.

this trade. Canvas sufficient to make a piece is wound on a wooden roller in the *frame-room*. In this room a number of substantial wooden frames are set up a few feet apart, and on these the canvas is to be stretched preparatory to the painting. The space of a few feet between every two frames is occupied by a scaffolding of four tiers, reached by means of a ladder placed at one end of each frame. The roller containing the canvas is set up on end, and rests on a low carriage, which is wheeled along as the canvas is unwound. But the first step is to bring it parallel with one of the upright ends of the frame, and make fast its edge by nailing it from top to bottom to the upright post. The unwinding of the canvas then proceeds, a temporary fastening being made to the top beam by means of a *quickset*, or arrangement of hooks, preparatory to the subsequent equable straining of the immense surface. When all the canvas is unrolled the other end is also attached to the frame; it is tightened by means of screws. The upper and lower horizontal edges have also to be secured to the beams and stretched out in a similar manner. The whole at length becomes nearly as tight as the head of a drum, and if this be done in dry weather and a change to wet suddenly take place, the tension is sometimes so much increased as to split the canvas.

In order to prepare this extensive surface for the reception of the paint, a weak solution of size is laid on with a brush, and while it is yet damp the canvas is well rubbed with pumice-stone. This softens down any irregularities, while the size fills up the interstices, and keeps the paint, which is afterwards applied, from penetrating too far, the effect of which would be to make the floor-cloth hard and brittle. This *size priming* and *pumice scouring* is carried on from the top of the frame downwards, one man applying the size, while two follow with the pumice-stones. The back surface of the cloth is primed first.

This first process being completed and the surface dry, a coat of paint is applied, stiffer than that used in house painting, and containing little or no turpentine. It is first thrown on in dabs with a short thick brush, shown in the man's left hand in Fig. 2, and afterwards spread with a steel trowel, Fig. 3, about 2 feet long, very elastic, and having the handle near one end. When a large surface has been gone over with considerable force the trowel is held obliquely, so that its edge alone may act, and thus a large portion of the paint is scraped off again, and the high threads of the cloth become visible. But the paint has been thoroughly worked into the web of the cloth, filling up inequalities and making the surface level. The *trowel colour*, as it is called, is left to dry during from ten to fourteen days, according to the weather; a second and thinner coat is then smoothly laid on with the trowel. This completes the operations for the under side of the canvas. But between the two coats of paint thus applied to the under side, the process is commenced on the upper side, or face, by applying size and pumice-stone as before. A trowel colour is also laid on, but when this is dry the face is carefully pumiced, in order to get rid of the slightest lump or knot. Two more trowel colours are added with the use of the pumice-stone between each. A fourth coat laid on thinly with a brush, and called *brush colour*, forms the ground of the future pattern, and completes the floor-cloth, with the exception of the printing.

The series of operations thus briefly alluded to occupies from two to three months, during which time, if the article be of the best quality, the canvas has increased in weight nearly fourfold; but if an inferior sort of floor-cloth be intended, then the number of coats and the weight will be proportionally less. The cloth is now to be removed from the frame on which all these operations have been carried on: this is done by running a sharp knife along the edges so as to detach it; it is then covered on the face with paper, rolled, and hauled up into the printing room above by means of ropes and pulleys. The printing is performed on a flat long table, and the floor-cloth is drawn up and along its surface in portions as required. Wooden blocks, similar in principle to those used in wood engraving, are employed to stamp the pattern, a separate block being required for each colour, sometimes seven or eight in number.

The engraved portion of the block is of pear-tree wood; to prevent warping, this is fastened to two blocks of deal, glued and pressed together so as for the fibres of each to cross the other at right angles. The printing surface is about 18 inches square, and is soaked in oil while new, that it may take up the colour more readily. The cost of a block, including the engraving, varies from 2 to 4 guineas, so that in large establishments, where several thousand blocks are required, the value of this portion of the stock is great. The blocks not in use are carefully preserved in a room in which a tolerably equal temperature is maintained throughout the year.

The printing of floor-cloth is thus conducted. On the table is placed a

number of flat cushions, each about 3 feet square, consisting of a pad of flannel covered with smooth floor-cloth. By the side of each cushion stands a pot of colour, from which a boy called a *tearer*, or *tierer*, takes up a portion with a brush and spreads it over the cushion, passing his brush from top to bottom, and then across the cushion, till a shallow but equable bed of paint is prepared. Each cushion receives one colour only. A portion of cloth being unwound and spread upon the printing table, a man hastily passes a steel scraper over it slightly to roughen the surface for receiving the colour, and a second follows with a hard scrubbing-brush for the same purpose. The printers follow next, their number agreeing with the number of colours to be printed. The first, holding his block by a handle attached to the back, presses it down on the cushion to imbibe the desired colour, then takes it to the cloth, and carefully placing it at the right-hand corner, holds it firmly, at the same time striking it several times with the handle of a heavy hammer. He then lifts up the block, and a clear impression is left of a portion of the pattern in one colour only. Taking a fresh charge of the same colour, he makes a second impression by the side of the first, and so on in regular rows along the whole extent of the cloth upon the table, taking care to keep his squares perfectly true and even. When this first printer has advanced a little way, a second charges his block with a different colour and begins precisely where his comrade did, delivering his portion of the pattern with a few strokes of the hammer, as before. After him follows a third, and as many more as may be required to form the most elaborate pattern. Thus the device is rapidly perfected, and the first printer, who is necessarily in advance of his comrades, has time to examine the work and to supply any flaws with paint of the proper colour, laid on with a camel's hair pencil. As the printing proceeds the cloth is turned over and gradually descends through an opening in the floor to the drying-room, where it sometimes remains for months. The process can be hastened by the use of drying oils, but this makes the floor-cloth brittle. Narrow widths of floor-cloth for passages, stairs, &c., are first cut the required width, and then printed in the same manner as the wide, except that a space is left on each side for the border, which is put on with smaller blocks afterwards.

Floor-cloth is largely used, but there are objections to it: it is too cold to the feet for a sitting-room; it has an unpleasant smell when new, and it must be admitted that very little art has been applied to its ornamentation, and the constant repetitions of marble and other pavements and flowery carpets have become tiresome. When the pattern is simple, flat, and equally effective when looked at from any direction, in few colours, and these harmonious, a good floor-cloth is a useful article and agreeable to the eye.

Of late years various substitutes for floor-cloth have been introduced, and some of them with marked success, under the fanciful names of kamptulicon, linoleum, suberium, cork-carpet, corticene, and boulinicon. They are none of them so cold to the feet as floor-cloth, nor are any of them so warm as carpet; their general colour and tone are pleasing to the eye, and they take ornamentation effectively. Considerable taste has been brought to the production of them, and the results are pleasing. These floor coverings may be seen in any town, and we shall therefore content ourselves with a few lines relative to their manufacture. All of them possess the advantage of greatly deadening sound.

Kamptulicon was, we believe, the first of these productions: its extraordinary name is made up of two Greek words signifying a flexible coverlet. It is composed of India-rubber and cork. Waste rubber is softened by steam, and then cut up by a revolving circular knife making its thousand revolutions per minute, by which it is reduced to small blocks, which are then passed several times between steel rollers of great power, which with the aid of water free it of clay and other foreign substances; it is then passed through other rollers of great strength, which reduce it to a consistent mass of a light brown colour. The friction is so great in this operation that much heat is evolved, and the water contained in the rubber is converted into steam and causes frequent slight explosions. The material is then submitted to the action of deeply indented rollers, which reduce it still more and mix with it the cork and colours. It is then passed through another apparatus which has four immense polished steel rollers, more than 5 feet long, and nearly 2 feet each in diameter. The first pair of rollers form the material into a sheet, and the second pair lay it down and press it into a canvas or other backing. Finally, the rubber is vulcanized by means of sulphur, at a temperature of 300° to 360° Fahr., and then the pattern is printed on it in much the same way as on oilcloth. Saw-dust, cocoa-nut, hemp, and other fibre are all said to have been used in place of the cork, but we cannot say with what effect.

Linoleum, which is in very extensive use, is made of linseed oil oxidized, mixed with ground cork and rolled on to a canvas back; the colour of the ground is either brown or red. It is claimed for this kind of floor covering that the patterns last longer than in the case of oil-cloth, as the colour sinks into the material. Corticene is a similar fabric.

Mr. Walton, the inventor, patentee, and successful introducer of linoleum, not long since produced a modification of this material for covering walls, and has succeeded in supplying decorators with an admirable covering for walls. This new kind of hanging stuff, called "muralis," has many qualities to recommend it: in the first place it is completely impervious to moisture, secondly, being subjected to great pressure, even those parts which are in relief may be hammered without sustaining the slightest damage, so that the fabric is practically everlasting, and, it may be added, is perfectly safe against the ravages of moths or any other insects; besides this, it requires no pasting, being fastened against the wall by means of small nails, so that it can be taken down and removed without difficulty; in addition to these important material recommendations, it is capable of a very high degree of ornamentation—patterns are impressed upon it in relief, and it will take any colour from what are called toned whites to the deepest tints, as well as gold, silver, or other metallic pigments. Mr. Walton has called to his assistance some of the most distinguished designers in England, and has produced patterns of great beauty in various styles, some of which can scarcely be distinguished from a costly and esteemed Cordova leather, while others are simple diapers or floriated designs in one or more colours. Muralis attracted considerable attention at the Paris Exhibition in 1878, and obtained for its ingenious inventor due recognition from the jury.

Boulinicon is formed of buffalo hide torn to fine shreds or rather fibres, wool and hair, all elastic and extremely durable substances; when these have been thoroughly mixed and felted together, the material is saturated with linseed or other vegetable oil, oxidized, and mixed with colour which gives the ground tint, which may be light or dark brown, or green. It is decorated in the same manner as linoleum or any of the other above-mentioned materials.

A large trade existed not long since in painted cloths for table-covers, table-mats, &c.; the groundwork was an even tissue of cotton or hemp, sometimes a baize, and the surface was painted by hand and frequently grained in imitation of mahogany or rosewood. Circular table-covers, table-mats, &c., were prepared in like manner, and afterwards decorated either by block-printing or stencilling: the decoration of these articles exhibited but little art to recommend them, and their almost total disappearance is not to be regretted.

The painted table-cover gave place to others which were printed and embossed on cloth or felt, which are rich in tone and generally simply decorated with central ornaments, corners, and borders in one or two colours in addition to that of the ground. The decoration when flat is produced by printing from wood blocks or cylinders; but when the pattern is raised the embossing press, or dies made of soft metal, and steam are employed.

Felt is produced by taking advantage of a natural peculiarity of hair, especially of the beaver, hare, and rabbit, of becoming interlaced one fibre with another, so that it forms a fabric which is not woven, yet solid. Whether for hat-making, for the production of felt for carpets or table-covers, the production of the felt itself is always performed in the same manner. The fine light felt used for hats is made of rabbits' hair, the coarser kinds of lambs', goats', sheep's and other wool and hair. The material, whatever it be, is laid on a table or bench with a back and sides, and made to fly up by the vibrations of the string of a large bow, as shown in the accompanying engraving. The effect of this is to cause the fibres to fall in all



Fig. 4.

imaginary positions, crossing each other in every possible direction; a piece of moistened blanket is then laid over the hairs as they lie and rubbed about in all directions, which causes the hairs to seize and twist one into the other and become inextricably matted together. By continuing this operation for some time with vigour a thin sheet of light felt is produced; upon this first sheet a second and third or more sheets, according to the thickness required, are formed in the same way, and the felt is finished in the fulling mill. The felting property of wool is greatly assisted by the crinkled fibre.

No. 12.—FULLING, TEAZLING, SHEARING, PRESSING, AND BLEACHING.



ONE of the most important operations to which woollen cloths and felt are submitted is that of fulling. The first operation the cloth undergoes after it is woven is *braying*, the object of which is to get rid of the oil used preparatory to spinning, and of the size used in dressing the warp. The cloth as it leaves the loom is greasy and rough, and it is subjected to a number of processes which make it compact in texture and smooth and level in surface. The first of these consists in working the cloth in the *stocks*. In this operation the *scouring-stocks* are used—a somewhat rude machine, which, under the name of the *fulling-mill*, is supposed to stand in point of antiquity next to the corn- or flour-mill.

The fulling-mill consists of two or more ponderous mallets of oak, working in a *stock*, as the frame of the mill is called. The mallets are worked by *tapit*-wheels acting upon their shanks, raising them to a certain height and then suddenly releasing them; this allows their heavy heads to fall by their own weight. The cloth is exposed to their action in an inclined trough the end of which is curved, so that the cloth is turned round and round by the action of the stocks, and every part in turn exposed to the blows. The trough contains some liquid detergent substance. It is more usual, however, to employ a machine called a *washer*, consisting of two large heavy rollers, either of wood or iron, the upper one resting on the lower; between these rollers the cloth passes, and dips down to a trough or bath of water or other liquid beneath the rollers. This form of washer is called a *scouring-machine* in Yorkshire. The detergent substances used in the stocks or in the washer are stale urine and hog's-dung: the action is continued for an hour, then the cloth is run through another washer with urine alone, and then with clean water until the latter runs away clear: a little fuller's-earth is also used in this process, and sometimes a small quantity of soda. The cloth is then dried by being hung up loosely in the stove—a large room heated by steam-pipes, and after drying it is *burled*. In this process a woman, called a *burler*, spreads the cloth over a sloping board in front of her, and passes her hand over the cloth to feel the knots which have been made by the weaver; these she picks off with a small pair of iron tweezers made on purpose, and in this way removes all knots and unevenness.

Milling.—The cloth has now to be *milled*. This is a very important process in the manufacture of broadcloth, as by it the fibres of the wool are felted together, and the whole surface of the cloth is covered with a thick fulled face. The stocks or fulling-mill consist, as above described, of an iron framework supporting the ends of two or more heavy wooden mallets, which are raised by projecting cams on a wheel which revolves under the nose of the mallets: the wheel raises the heads of the hammers to their full height, and then, releasing them, allows them to fall by their own weight on the cloth, which is contained in a sort of iron trough beneath the mallets. Soap is used in this process. The bars of soap are first converted into shavings by a rough plane, and these are dissolved in hot water. The soap is distributed over the cloth by pouring it into a fold near one of the ends; the man then takes up this fold and pulls out the cloth so as to form a sort of channel, along which the solution of soap flows until the cloth has absorbed it all. The cloth is taken out two or three times during the process of milling to prevent its forming into wrinkles.

An ordinary broadcloth will take from 60 to 65 hours to mill, and will require about 11 pounds of soap; it will shrink during the process from 12 quarters wide to 7, and from 54 yards long to 40. A Venetian will require about 12 hours, take from 6 to 7 pounds of soap, and shrink in width from 7 quarters 3 nails to 6 quarters 2 nails, and in length from 54 yards to 45 yards. A fancy heather will require 10 hours, take 10 pounds of soap, and shrink in width from 7 quarters 2 nails to 6 quarters 2 nails, and in length from 54 to 49 yards. After the fulling, the cloth is passed through a washer with clean water, to remove the soap.

A great improvement has of late years been introduced to supersede the old fulling-stocks: a machine called the *fulling-machine* is now come into general use; it is more convenient, does the work in a shorter time, and requires less soap. It consists of a strong iron framework A A, Fig. 1, supporting a wooden case B B, which is screwed on to it; C C are strong cogwheels, the lower one of which is set in motion by the drum K, Fig. 2. On the axis of these wheels are fixed two narrow wooden rollers, which are shown in section in Fig. 3; the lower one D has a copper flange on each side, the use of which will be noticed presently. On a horizontal line, passing between these rollers, there is fixed a sort of trough or shoot F, a part of the top of which is movable on a hinge, as shown in Fig. 3: at

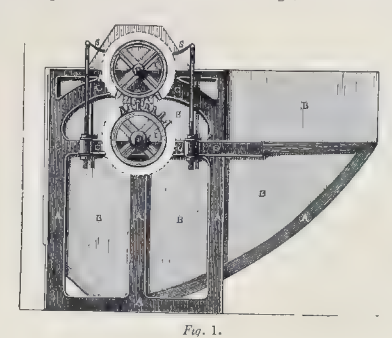


Fig. 1.

the end of this movable lid there is a kind of box H, in which weights are placed. The upper roller E is pressed on the lower one by the springs S, the force with which they press downwards being regulated by the nuts at



Fig. 2.

the ends of the rods attached to the springs. The cloth is shown in Fig. 2 in the position which it occupies while being milled; the two ends of the cloth are fastened together so as to form an endless cloth. Passing through two holes in the piece of wood O, the two parts of the cloth pass together over and between guide-rollers till the united cloths pass between the rollers E D, being kept in place by the copper flange before mentioned. The action of these rollers forces the cloth on into the trough F, where it is doubled and folded up in the way represented, the weights in the box H preventing it from passing freely out of the trough. The force thus exerted between the rollers and in the trough has the effect of milling the cloth and causing the fibres to felt together just as in the stocks. Soap is added by being poured on the cloth in front of the machine as it is at work, the doors D D being made to open for that purpose.

Teazling.—After being dried, the cloth has to be *dressed*; this is done at the gig-mill. It is first *roughed* or *rowed*, by being teazled both ways for about 20 hours, so as to raise the wool. The operation of teazling is performed by means of the prickly flower-heads of the teazle (Fig. 4), a species of thistle (*Dipsacus fullonum*) which is cultivated in the clothing counties for the purpose. From 2,000 to 3,000 teazles are used on a piece of cloth 40 yards long; each head consists of a large number of flowers, separated from each other by long scales, at the end of which is a fine hook which forms the efficient part of the teazle. These natural hooks are sufficiently strong to overcome slight impediments, but if they

become fixed in a knot which they cannot disentangle they break. It is this property, so difficult to imitate, which has hitherto prevented the intro-

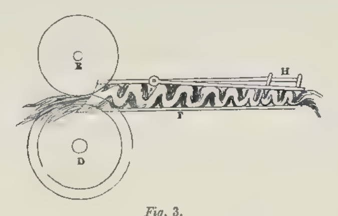


Fig. 3.

duction of wire brushes or metallic teazle-cards, as their points or hooks, instead of yielding, tear out the fibres and injure the surface of the cloth.

In the *gig-mill* (Fig. 5) the teazles are arranged in long frames attached to a hollow drum or cylinder, and the cloth, guided by a number of rollers,



Fig. 4.

is moved in a direction contrary to that of the cylinder, by the rapid revolution of which, and the slower motion of the cloth in a contrary direction, the loose fibres of the wool are brought to the surface.

Shearing.—The filaments drawn out by teazling are of unequal length, and require to be shorn to make them level. The *shearing* of cloth is an important operation, and is varied according to the quality of the material and the appearance required. It was formerly done by hand with a pair

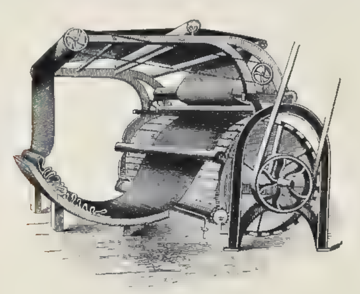


Fig. 5.

of shears, and the introduction of machinery for the purpose at the beginning of the present century led to serious riots in the West of England. The machine which is chiefly used for the purpose is *Lewis's cutting-machine:* it consists of an iron cylinder (the length of which is equal to the width of the cloth) with cutting-blades passing spirally round it, and a straight steel blade fixed in contact with these other blades and parallel to the cylinder. Anything placed between this blade and the cutting-blades will, when the cylinder is turned round, be cut as if with a pair of scissors; the whole apparatus is movable on a hinge. The cloth passes over another steel blade directly below the cutter, and thus the wool is exposed to the action of the latter, which, rapidly revolving, shears it off. The depth to which the cutter is allowed to fall on the cloth is regulated by small pieces of paper put under a projecting stud, and the falling out of one of these papers is sufficient to damage the piece of cloth. The whole cutter is supported on a frame, and travels over the cloth across its width; as soon as it has been over once it is drawn back, the cloth is shifted on, and the cutter again travels over it. Two boys generally attend to two cutters, and one man has the superintendence of the shop, and attends to the papers, and regulates the depth to be taken off at each kerf or cut. This is a delicate operation, as the cloth requires to be cut many times: if too much were taken off at once the surface of the cloth would be injured.

Pressing.—The next of the finishing processes is to arrange the cloth in regular folds, and submit it to the action of a hydrostatic press. A polished pressing-board is placed between the folds, to prevent the surfaces of the cloth from coming in contact; and the pieces of cloth, where many are pressed at the same time, are separated by an iron-plate between every two pieces. For hot-pressing, three hot iron plates are inserted between the folds at intervals of about 20 yards, and the heat of the plates is moderated by thin sheets of cold iron placed above and below the hot plates. The pieces of cloth are piled up in the press, and subjected to an intense pressure, which is maintained until the plates become cold. The cloth is then taken out, and folded again in such a way that the creases of former folds may come opposite the flat faces of the pressing-boards and be removed at the second pressure. Hot-pressing gives a satiny lustre and smoothness to the face of the cloth; but as this is apt to become spotted by rain, another process has been introduced, namely, boiling. The cloth is tightly wound upon a wooden or iron roller, and immersed in water, heated to 170° or 180°, for five hours; it is then taken out and allowed to cool for twenty-four hours. It is treated in this way four or five times in succession, and then washed with fuller's-earth. After this it is racked, or stretched tightly on an iron frame called the *rack* or *tenter*, in a stove, or room, heated by steam pipes.

In place of the roller-boiling another process is now often adopted, called steaming. After the cloth is hot-pressed, it is rolled round a copper cylinder perforated with a number of holes, a piece of cloth being wrapped round the roller first, to protect the cloth from being coloured by the copper: steam is then admitted into the roller, and allowed to pass through all the folds of cloth. If high-pressure steam be used, this will be effected in five or ten minutes; but if the pressure be low, it will require one and a half hours: after this it is boiled twice. This steaming process saves the time of three boilings and gives a nice satiny finish to the goods.

Several of the processes which we have thus described separately, are frequently alternated with each other. The cloth is passed several times through a brushing-machine, consisting of a series of brushes attached to a cylinder. In passing through this machine the face of the cloth is softened by being slightly damped by exposure to steam, which escapes in minute jets from a copper box extending the whole length of the brushing-machine.

In finishing the cloth previous to cold-pressing, it is carefully examined before a strong light, and *picked*, *fine-drawn*, and *marked*. Picking is similar to burling, its object being to remove blemishes from the surface, and to cover any spots which may have escaped the action of the dye by touching them with a pen dipped in dye-stuff. The object of fine-drawing is to close any minute hole or break in the fabric, which is done by introducing, by means of a needle, sound yarns in the place of the defective ones. Marking consists in working in with white or yellow silk a word or mark, indicating the quality and number of the piece. The cloth is lastly made up for the market in *pieces* or *bales*, and into *ends* or *half-pieces*.

The Jury Report for 1851, Class XII., states that "The Continental methods of producing a permanent face are totally different, much shorter in their processes than ours, and performed at a much cheaper rate. Their methods are—the one by rolling the cloth tightly round a hollow perforated cylinder, into which the steam is introduced to produce the desired effect; the other, and more general one, by folding the cloth and putting it under very powerful pressure, then allowing the steam to penetrate the whole bulk. Both these methods cause a hardness which is observable in all Continental productions, and would be more so if applied to stouter fabrics. There are also to be seen on cloths that have been so treated marks of the folds, which cannot be effaced by any ordinary means. Several houses in Leeds have tried this plan, but found that the fold-mark and hardness of the fabrics formed obstacles to their sale in the home-market, though not for exportation; consequently it has been adopted to meet the competition abroad.

"Considerable attention has been given to the dyeing of cloth in the different countries, especially the finer fabrics, which are all equally well and permanently dyed. In the middle qualities, some are permanently dyed, and others not; this is the case in all countries, and in the lower qualities (with some few exceptions) they are all of a common dye. This is a circumstance easily accounted for by the cost of the permanent dye being considerably more, and from its detracting slightly from the appearance and feel of the cloth—facts which, it must be admitted, are great impediments in these competitive times, although there can be no doubt that real and ultimate economy must remain with a permanently dyed article."

We must not omit all mention of a material which has given rise to much comment and discussion—namely, shoddy, which is obtained from cuttings and rags of all kinds of woollen and worsted fabrics. It is about half a century ago that a mill was set up to tear scraps and rags into "rag-wool." At first the adoption of shoddy was slow; but during the last quarter of a century it has gone on increasing at a rapid rate—so much so that in the Jury Report on the Exhibition of 1862 it is said that if the

supply of shoddy were stopped, the price of wool would probably be doubled; millions would be deprived of their cheap, warm winter garments and their light, useful summer clothing, and one-third of the woollen mills would be brought to a standstill.

There are three kinds of rag-wool: shoddy, mungo, and extract. *Shoddy* is made from blankets, flannels, stockings, and other soft materials; *mungo* from fine cloth cuttings and woollen rags, that made from the former being called new mungo, and fetching a higher price than the old. *Extract* is wool obtained from the rags and cuttings of mixed goods, tissues formed partly only of wool, by chemical processes, which destroy the cotton or other matters and leave the wool free. These processes have of late been brought to great perfection, and there is a statement made, which we cannot verify, but which we have no reason to doubt, that garments made of this chemically extracted wool are never attacked by moths.

Bleaching is such an important process that it is difficult now to realise the fact that formerly our cotton and linen goods were sent to Holland to be bleached. The Dutch had the secret of preparing the goods, and the bleaching was completed by exposure on grass to the sun and sprinkling with water for several months until the desired whiteness was attained. Goods sent in March were returned in the autumn; to this fact is due the name of *holland*. Bleaching was commenced in Scotland about the middle of the last century, and the process consisted of alternately steeping the goods in lye and spreading them on the grass. The method was very costly, it took a long time and much labour, required a large amount of ground, and held out temptation to robbery. In 1785, Berthollet, the famous French chemist, discovered that a solution of chlorine had the power of destroying vegetable colours; this he communicated to Watt, who was in Paris, and by whose means it was tried by his father-in-law, Mr. Macgregor, near Glasgow. The experiment was perfectly successful, but the gas had a very deleterious effect on the men employed in the works: this, after several attempts, was removed by Mr. Tennant's production of chloride of lime, well known now as bleaching-powder. The chloride of lime thus formed is used in enormous quantities in the bleach-works of Great Britain, most of which are situated in Lancashire and in the neighbourhood of Glasgow. As the various processes require an abundant supply of pure water, the works are usually situated near some stream.

As soon as the goods are received at the bleach-works, the end of every piece is marked with the proprietor's name, which is done with a needle and thread, or with a wooden stamp moistened with coal tar. The fibrous down or nap on the surface of the goods is then burnt off by a process called *singeing*, which greatly improves their appearance, and in the case of dyeing or printing enables the cloth to receive the dye or pattern more perfectly. In this process a number of pieces of cloth are fastened together at the ends by means of long wires, and then wound upon a roller furnished with a winch. The cloth is then drawn over a half-cylinder of copper made red-hot by being built into a horizontal flue. As soon as the cloth has passed over the heated metal, it is wound upon a second roller which plays in a trough of water. The cloth is usually passed three times over the hot surface, twice on the face, or the side intended for printing on, and once on the back. It is wound from one roller over the heated metal to another roller on the other side of the furnace, a swing frame being placed for raising the cloth at any moment out of contact with the heated metal, and water is at hand in case of accident to the goods, which is a rare occurrence. By this operation the goods become browned and discoloured. Gas flames are used for singeing thread, muslins, and bobbin-net lace. The flames issue from numerous perforations in the upper surface of a horizontal tube, and the fabric to be singed is drawn over the flame upon rollers with a rapidity adapted to the texture of the goods. The flame is drawn up through the web by placing immediately over the gas-flame a horizontal tube with a slit in its lower surface. This tube is connected with a fan or other apparatus for withdrawing the air from it, and thus increasing the draught of the flame.

After singeing, the cloth is steeped in a cistern of water, and, in order to ensure contact with the water, each piece is pulled out, folded loosely, and tied up, with a noose at the end, into an irregular bundle. After soaking twelve or fourteen hours, the pieces are washed in a *dash* or *wash wheel*, which is a hollow, circular, perpendicular wheel, 5 or 6 feet in diameter, and nearly 2 feet in depth. It is divided into four equal compartments by partitions proceeding from the axis to the circumference, each of which has a circular opening on one face of the wheel (Fig. 6). Water is admitted into the compartments by a pipe concentric with the axis on which the wheel rotates. The pieces to be washed are put into the compartments through the circular openings in front, and water being admitted, the wheel is made to rotate rapidly and thus wash the cloth with considerable agitation. The object of this washing is to remove as much of the dirt and weavers' dressing as possible; but, as the grease cannot be removed except by making it soluble by the action of an alkali, lime is economically employed. The pieces are therefore boiled with lime in a large circular boiler, or keir, called a *bucking* or *bowking keir*, or *puffer*.

A bleacher now can turn out a thousand yards of calico a day. Linen is rather more difficult to bleach. Wool is bleached by means of sulphur, as are straw hats and bonnets, and other articles; the bleaching-room is arranged with poles, so that the goods may be hung up, the brimstone is set on fire in shallow dishes, the door is tightly closed, and in a few hours the bleaching is effected. Mousseline de laine, which is formed of cotton and wool, is passed two or three times through a bath of soap and soda at a heat of about 130° Fahr., then sulphured for several hours, and finally passed through a very weak solution of caustic soda, dried, and usually impregnated with a dilute solution of tin, which gives much brilliancy to the colours afterwards applied to the fabric.

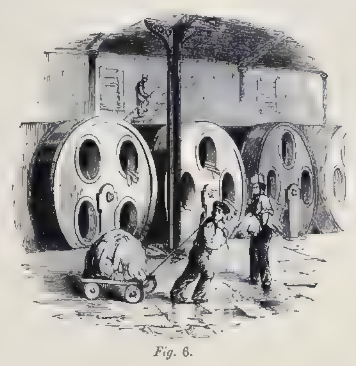


Fig. 6.

Technical terms often give the learner much trouble, and he will be glad to have them explained. In bleaching-houses boiling is called *bucking*, or *bowking*, recalling the "buck-basket," mentioned in *The Merry Wives of Windsor*: the iron vessel in which the goods are boiled is called a *keir*; the bleaching-ground used to be called a *croft*, and exposing the goods there to the effect of the sun *crofting*.

Carefully arranged keirs heated by steam are now used in place of the old basket and boiler system. The old washing-stocks have also been superseded by washing-machines, which cleanse from three hundred to eight thousand pieces of goods in a day, and require from fifty to four hundred gallons of water per minute! These figures will give some idea of the amount of work done in the great bleaching-works of Lancashire. After bleaching, the fabric is dried by being run through great wooden rollers, or *squeezing-bowls*, which take out nearly all the water; next it is *spread*, or smoothed out, either by the hands of women or by a machine called in Manchester a *candroy*; finally it is mangled by being passed through steam-heated rollers, for which purpose the ends of a number of pieces are tacked together, so that they may run through at high speed. If it be intended to be printed, it is now ready, but if to be sold as calico it has to be starched and calendered, or *finished*, as described in our next treatise.

There is a system invented by Mr. Bentley known as the continuous process of bleaching, in which a number of pieces, all joined together end to end, are made to pass through all the solutions required to be used in continuous progression, and then between two sets of calendering rollers.

In the inventor's own words, in this system rapid motion and frequent pressure take the place of a still, soaking process. Another advantage is the avoidance of having to carry the goods about from one part of the bleaching-house to another, which of course gives rise to the employment of many hands under the ordinary system. This new system, however, is only applicable to cotton, not to linen goods.

Silk is not bleached in the same manner as cotton or linen; the gummy matter is got rid of by scouring and boiling, "ungumming," as it is called. It is boiled in hanks in lather with soda, then very carefully washed several times, the pearly appearance being given by the addition of a little indigo, or archil, according to the tint required. All silks, except china white, lose four to five ounces in the pound by bleaching.

Wool is bleached, or rather ungreased or scoured; the diminution amounting to about a third in the case of ordinary wool, and to nearly half in that of the finer sorts. The wool is steeped in warm water containing a fourth of stale urine, being stirred about in it for a quarter of an hour or more, and then put into baskets and rinsed in cold water. Wool is sometimes bleached in the fleece, but the operation succeeds best on the yarn. Finally, it is submitted to the fumes of sulphur for several hours, and then washed for four or five hours in cold water containing a little finely ground indigo. Welsh flannel is bleached with fuller's earth and ammonia, and not sulphured; its tint is also given by means of indigo.

No. 13.—CALENDERING, WATERING, AND EMBOSSING.



CALENDERING is merely pressing by means of rollers. After the cotton or linen has been bleached it is passed through water and a pair of rollers to get it laid out without wrinkles or folds. The machine used for calendering consists of a number of rollers fixed in a strong upright frame, the rollers being forced together by levers to which a considerable weight is attached, or by means of screws, as in Fig. 1.

The object of calendering white goods is appearance only; but for prints it is of the utmost importance that the round forms of the threads should be flattened, so as to take the colour more evenly and completely.

The starch used in calendering is made from flour deprived of gluten by fermentation in water, in the proportion of a pound of flour to a gallon of water. The whole is passed through a sieve after fermentation, and this

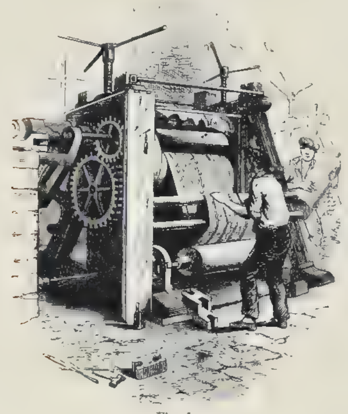


Fig. 1.

separates the bran. The flour is then boiled, and a small quantity of indigo added to give it a blue tint, after which more water is added according to the degree of stiffness to be given to the goods. This liquid is frequently thickened with porcelain clay, calcined plaster of Paris, or both, in order to give an appearance of strength and thickness to the cloth. This all disappears as soon as the goods are washed; therefore it merely makes them more attractive to the eye of the purchaser.

The method of applying the starch is by a stiffening mangle formed of rollers of brass and wood pressed together by levers. The starch is contained in a trough, into which a roller dips, and the cloth in passing under this roller becomes filled with starch, the superfluous part of which is pressed out again by the upper rollers and falls back into the trough. The next operation is drying, which in the more substantial goods is effected by passing the goods over large tinned iron or copper cylinders, Fig. 2, heated by being filled with steam; but for muslins the process



Fig. 2.

merely consists of stretching out the material on long frames in a warm room. This is done with such celerity that two young women can stretch a piece twenty-five yards long, and fasten it to the frame by pressing down numerous clamps prepared for that purpose, in the space of two minutes. For *patent finish*, the two long sides of the frame are made to work backwards and forwards in opposite directions, giving the muslin a diagonal motion, which is continued till it is quite dry. The effect of this is to make the muslin very clear and elastic.

Cotton goods before calendering, must be damped by passing slowly over the *damping* or *degging machine*, Fig. 3, containing a circular brush,



Fig. 3.

the points of which, as they rapidly revolve, just touch the surface of the water, and dash up a cloud of fine spray against the cloth, which thus becomes uniformly damped.

With considerable pressure between smooth rollers, a soft and silky lustre is given by the equal flattening of all the threads. By passing two folds at the same time between the rollers, the threads of one make an impression on the other, and give a wiry appearance with hollows between the threads. This may be varied at pleasure. The rollers are of cast-iron, wood, or paper, according to the uses for which they are designed. Paper rollers are in fact a mass of circular discs of pasteboard, threaded upon a square bar of wrought iron and secured by iron discs at each end screwed down tightly. The roller is then placed in a hot stove for several days to drive off all moisture, when the screws are tightened and the cylinder becomes so dense that in being finished at a turning-lathe it blunts all the tools employed, and requires two men to be kept constantly at work sharpening them. Copper embossed rollers are used for producing figures and patterns. The roller is heated by the insertion into it of a red-hot cylinder. An embossing machine is shown in Fig. 4. Calico "cloth," for

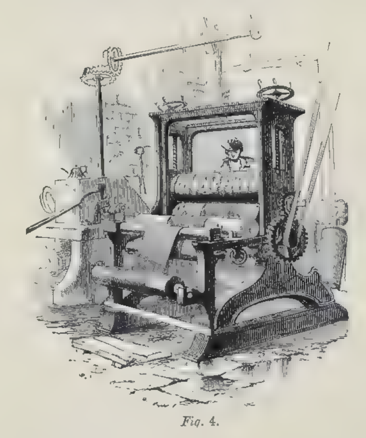


Fig. 4.

bookbinding, is impressed either with an engraved or engine-turned pattern, or an imitation of the grain of morocco leather. Silk is watered, or *moiré*, by being carefully folded, slightly damped and submitted to excessive pressure, amounting sometimes to a hundred tons, the marks known as watering being produced by the imprisoned water and air.

No. 14.—DYEING.



YEING is one of the most general and most interesting operations belonging to textile manufacture. Nor is it confined to textile fabrics: leather, feathers, ivory, bone, wood, flowers, grasses, and many other things are dyed; but the great work of the dyer is the giving colour to silk, wool, flax, or cotton, either in the form of yarn or woven fabric. Dyeing is specially interesting not only for the great beauty of its results, but for its scientific character, for the immense quantity of materials with which it deals, and especially for the great progress which has been made in the art of late years, and which is still going on.

Some ancient colours have become proverbial: amongst others the Tyrian dye, colouring matter obtained from two species of shell-fish, which was enormously costly, and since the discoveries of modern times possesses now no other than an antiquarian interest. The Greeks did not pay much attention to dyeing; they wore clothing of the natural colour of wool and other materials. The Romans of the later times were extravagant with respect to colour as in everything; they are said to have paid as much as thirty pounds, English money, for a pound weight of a fabric dyed of the true Tyrian colour. The Florentines revived the art in Europe in the thirteenth or fourteenth century, after it had been lost for some time, and brought it to great perfection; and all the Eastern nations understood the application of colours from an early period of the world's history, and the perfection of the colours of Indian and Chinese silks and woollens is still unsurpassed. We cannot afford space to enter further into the consideration of the history of the art, beyond adding to what we have already stated that some of the important secrets of the art came from India through Greece, which, little more than a century ago, taught the French how to dye Turkey red, and Mr. Wilson, of Ainsworth, near Manchester, learned the same secret, and brought it to this country soon afterwards.

India and America have supplied Europe with a variety of new colouring-matters, such as indigo, logwood, quercitron, Brazil-wood, cochineal, arnotto, &c. Before the introduction of indigo, woad was used for dyeing blue, and the cultivators of this plant in England and on the Continent endeavoured to prevent the use of indigo, which, by a decree of the German Diet in 1577, was declared to be "a pernicious, deceitful, eating, and corrosive dye." The introduction of logwood was opposed from similarly interested motives: its use was prohibited by a statute of Elizabeth, under heavy penalties, and all that which was found in the country was ordered to be destroyed: it was not until the reign of Charles II. that its use was permitted.

The methods of imparting a permanent colour to textile fabrics are almost as numerous as the colouring matters employed. Most of the colours used in dyeing are vegetable: a few are animal and mineral. The most vivid and brilliant vegetable colours, such as those of flowers and other parts of plants exposed to the light, are small in quantity, very fugitive and difficult to separate. The colouring matters extracted from plants are mostly yellow, brown, and red; the only blue dyes furnished by plants are indigo and litmus. Most vegetable colours are soluble in water, and those which are not so can be dissolved in alcohol, ether, or the fixed oils. Vegetable colours are permanent in dry air; but they gradually fade in moist air, especially under the influence of light. The blue of most flowers is converted into red by an acid, and into green by an alkali. Of late years an extraordinary revolution has taken place in dyeing by the introduction of aneline and other colours derived from the refuse of gas-works: many of these colours are extremely beautiful, and the greens have the peculiar property of appearing of the same tint in artificial light as in that of the sun.

Not only do the methods of dyeing vary with the nature of the dye-stuffs, but also with that of the material to be dyed; different methods being adopted for cotton, silk, and wool. In order to convey a general idea of the art, we will refer principally to the dyeing of cotton, which receives colour much less easily than wool and silk, and therefore requires more numerous and elaborate processes.

The appearance of a large dye-house is very interesting from the variety and magnitude of the processes carried on therein. The following is a general sketch of the Egerton Dye-works at Turton, near Bolton.

"The dye-house at Turton consists of an immense apartment, which forms the basement story of a large cotton-mill. It is paved with stone, and supplied with acomplete system of drainage for carrying off the spent dye-stuffs and soiled water which result from each day's operations. On entering this apartment, the visitor is struck with what appears to be the confused assemblage of differently-shaped machines, unlike the sameness which is equally remarkable in the grouping of the machinery of a spinning or weaving mill. Here are large stone cisterns for bleaching and for washing; dash-wheels, and other wheels, also for washing; vessels containing dye-stuffs called *dye-becks;* others, containing soap and water, called *soap-becks;* mangles for rolling the cloth; others furnished with brushes for laying the fibres all in one direction; squeezing rollers for pressing out the water from the goods, and a curious machine for drying the goods by centrifugal force. Under the feet are streams of all colours threading their way through the dregs of other spent dye-stuffs which had been thrown away some time before. Occasionally may be seen a vessel containing a liquid which is boiling without any visible source of heat. Heat, however, is supplied by the introduction of steam from a large boiler in a neighbouring apartment. There are also conveniences for supplying water to almost any amount. In some dye-works the daily consumption amounts to from 600,000 to 800,000 gallons. The purity of the water is of the utmost consequence; distilled or rain water, or that of an artesian well, is generally better than spring or river water, which usually contains lime, and this exerts an injurious action on the dye-stuff: there is also a small quantity of iron in most spring and river water, which gives a brown tinge to goods washed in them. Adjoining the dye-house is a room for storing, grinding, mixing, and dissolving the various dyeing materials, salts, &c. Infusions of such drugs as fustic, sumach, and logwood are made in tubs or vats; 50 lbs. of the drug being mixed with 200 gallons of boiling water. Some of the vats are furnished with a perforated false bottom, to separate the solid matter from the infusion. A decoction of sumach is obtained by boiling it in an open copper boiler, which is the vessel usually employed for decoctions. For some delicate dyes, where a steam heat is applied, vessels of tinned iron or copper are use. Different vegetable colouring matters vary so much in their properties, that few general observations apply to all of them. If the substance be very soluble, its solution is usually made in cold water: if only slightly soluble, heat is applied, provided the colour is not injured thereby. When the solution is required to be highly charged with colour, a portion of the water is driven off by heat; but this requires caution, as many vegetable colours are injured by long boiling. If the goods be not kept in constant motion when in the dye-beck, the infusion should be previously filtered, or the clear part poured off, to separate insoluble woody matters. In some cases a coloured infusion is obtained by enclosing the colouring substances in bags, which are removed from the liquid when sufficient colour is imparted. If, however, the goods are kept in continual motion while in the dye-beck, as is almost always done with cottons, the separation of the insoluble matters is immaterial. The vegetable material is commonly introduced in a state of coarse powder into the dye-beck containing cold water: the pieces of cotton are put in at the same time, and the temperature of the liquid gradually increased by the introduction of steam by a pipe connected with the boiler. Motion is given to the goods in the dye-beck by a winch or reel placed horizontally over the middle, so that the cloth may be made to descend into either compartment of the dye-beck by the rotation of the wheel. By another arrangement the cloth is wound from one roller to another, passing in the interval through the dye, under a roller placed at the bottom of the beck."

The fibres of vegetable and animal substances receive colour more readily before they are spun into yarn, and the yarn admits of being more readily dyed than the woven cloth, because the solution of colouring matter has more difficulty in penetrating the twisted than the open fibres. Thus wool in flocks, after having been washed in an alkali and bleached, takes more colour than when it is spun or woven; and the colour of the interior of a piece of thick woollen cloth, dyed in the piece, is often less intense to the eye than the colour of the exterior. Dyeing in the piece is, however, less expensive than dyeing wool in flocks or in yarn, because less of the material is used, and the colour is not exposed to injury during the processes of spinning and weaving.

In dyeing cotton goods several pieces are usually joined together, to

make a length of from 100 to 120 yards. Several processes preparatory to the dyeing are required. The goods are first scoured, and in some cases boiled in acid water or in alkaline ley, for about two hours, then wrung out and rinsed in a stream of water until the water comes off clear. The acid water is prepared by the addition of sulphuric acid, and when the stuffs are steeped in it the acid combines with the calcareous earth and iron contained in the fabric, the presence of which would interfere with the full effect of the colouring matter.

In the dyeing of cotton, *aluming* is an important preliminary process. 40 or 50 lbs. of alum previously dissolved in warm water are mixed in a vat with 40 or 50 pailfuls of water, the mixture being carefully stirred to prevent the salt from crystallizing. Each pound of cotton stuff requires 5 oz. of alum, with a little soda, tartar, or arsenic. The threads of the fabric are impregnated by working them in small quantities of this solution. After this has been done some time, the whole of the liquor is added, and it is left for 24 hours, after which it is washed in running water for 1½ or 2 hours.

Galling is another preparatory process. Powdered galls are boiled for two hours in water, the quantity of which must be regulated by that of yarn to be galled and the amount of the effect required. When the solution has cooled down it is divided into a number of equal parts, in order that the yarn may be wrought pound by pound. The whole stuff is then put into a vessel, and the remaining liquid poured upon it. It is left for 24 hours if to be dyed black, but for other colours 12 or 15 hours suffice. It is then wrung out and dried.

In passing the goods through these preparing cisterns, the effect desired is produced more effectually and in quicker time by allowing the cloth to unwind gradually from a roller, and, after going through the liquid in a regular manner under a roller at the bottom of the vessel, to pass between two rollers on coming up out of the liquid, whereby the superfluous moisture is pressed out of the cloth and it is again prepared for another dipping.

Dyeing depends upon the principle of chemical affinities, one of the most interesting, though one of the most complicated of scientific subjects, but one which will repay any one for its study even if only as a mental exercise. In plain, unscientific language there is affinity, attraction, or repulsion amongst almost all substances; thus compositions and decompositions take place in the dye-vat, and the colouring matter is produced in or upon the cloth in the form of an insoluble precipitate by mixing two solutions, in neither of which does the colour exist separately. The advantage of this method is, that the cloth can be impregnated with one solution, and then, upon immersing it in the other, the insoluble colouring matter is formed within the elongated cell or tube which forms the fibre of the cloth, so that the resulting precipitate being, as it were, imprisoned within the fibre, is rendered incapable of being removed by washing. In this way mineral colours, such as chrome-yellow, prussian-blue, iron-buff, and manganese-brown, may be applied to textile fabrics. In all these cases the proper colouring matter is insoluble in water, and is precipitated whenever the two solutions proper for its formation are mixed. Thus, when an aqueous solution of bichromate of potash is mixed with an aqueous solution of acetate of lead, an insoluble precipitate of chromate of lead (chrome-yellow) is produced. In the processes for dyeing cloth with mineral colours, the fastness of the colours is supposed to be entirely a mechanical effect, in no way referable to a chemical attraction of the fibre for the colouring matter. A piece of white cotton cloth moistened with either a solution of bichromate of potash or of acetate of lead may be easily cleared of either of these salts by washing it in water; but if the cloth be first impregnated with one solution, and afterwards with the other, the precipitate of chrome-yellow produced within the fibre can never be removed by washing with water. The chrome-yellow that is afterwards washed away is merely attached loosely to the exterior of the fibre.

A second method of dyeing is with a *mordant;* this is usually a metallic salt which has an affinity for the tissue as well as for the colouring matter in solution, forming with the latter an insoluble compound. This method of dyeing is useful for all those vegetable and animal colouring matters which are soluble in water, but have not a strong affinity for tissues. The action of the mordant is to withdraw them from solution, and to form with them, upon the cloth itself, certain compounds which are insoluble in water.

In dyeing cotton with a mordant, it is generally necessary that the mordant be produced on the cloth in a form insoluble in water; but in order that it may penetrate to the interior of the cloth about to be dyed, it must first be applied in a state of solution. The excess of mordant is then removed; for, if allowed to remain, the dye would be formed chiefly on the surface and only a small quantity would penetrate the fibre. But when the surplus mordant has been removed, and the cloth passed through the dye-beck, the resulting colour is often dull and liable to change, apparently because the quantity of mordant is too small to combine with all the colouring matter which is deposited. But on applying the same or some other mordant a second time, the colour is greatly improved in lustre and becomes permanently attached. This second mordant is called an *alterant.* Thus, if a piece of white cotton be removed at once from a dilute solution of perchloride of tin to a weak decoction of logwood, the cloth assumes an uneven violet colour, which can be removed by washing. But if the perchloride be removed from the surface of the cloth before it is put into the decoction, the piece assumes a dull, brownish, violet tint. If a small quantity of acetate of alumina be then added to the liquor as an alterant, the cloth acquires a good permanent violet or purple colour. When the surplus mordant has been removed, the sooner the goods are exposed to the dye-stuff the better in general is the colour they assume.

When the dye-stuff is insoluble in water, a third method of dyeing is adopted. In such case, the mordant may be dispensed with; but it is necessary to make such a solution of the colouring substance as will allow it to be precipitated, in its insoluble state, when a cloth impregnated with the solution is exposed to some chemical agent.

The most important insoluble vegetable colours are indigo, safflower, and arnotto, and some yellow and brown dyes. To bring these into a state of solution, it is necessary to employ some other solvent than pure water. By exposing indigo to the action of some body which robs it of oxygen, it is brought to the state of *white indigo*, or *indigotin*, which is soluble in water, if lime or some other alkali be present. If a piece of cloth be dipped in such a solution, it becomes impregnated with white indigo, and on exposing the cloth to the air it imbibes oxygen, by which it becomes converted into its original insoluble blue. This remains firmly attached to the fibre, and cannot be removed by washing in water. The calico to be dyed is stretched in perpendicular folds on rectangular wooden frames. The solution of indigo is contained in stone cisterns or vats, the tops of which are on a level with the ground. In preparing a new vat, 50 lbs. of indigo are reduced to an impalpable powder, by grinding with water during ten or fourteen days. This powder is then mixed with hot water, and the requisite quantity of lime added, after which a solution of sulphate of iron is stirred in. Sulphate of iron consists of the protoxide of that metal dissolved in sulphuric acid: this protoxide converts the blue indigo into white indigo, which the presence of the lime enables the water to dissolve. The calico being properly stretched, the frame is lowered into a nearly spent vat and allowed to remain 7½ minutes; it is then taken out and left to drain for the same length of time, during which it becomes of a green colour; the frame is then turned over and immersed in the second vat, which contains a little more indigotin than the first; after remaining in this during 7½ minutes, it is taken out and exposed to the air for another 7½ minutes; it is treated in this way up to the tenth vat, which contains the largest amount of dyeing material. On being removed from this, it is of a deep blue colour.

The colouring matters of arnotto and safflower are scarcely soluble in water; but they dissolve readily in alkaline liquors, from which they may be precipitated by an acid. A piece of cloth being impregnated with an alkaline infusion of the dye-stuff, is readily dyed by passing it through a weak acid. In practice, however, it is found desirable to add the acid to the alkaline infusion of the dye-stuff, so as nearly to neutralise it; by this means the colouring matter is held in a state of feeble suspension, and readily attaches itself to the surface of the cloth.

The last method of dyeing which requires to be noticed in this place, is practised only on goods formed of animal fibres. By this method, which is called *mandarining*, an orange colour is given to silk and wool, not from the solution of a colouring matter, but by producing a certain change in the fibre by the action of dilute nitric acid. The orange colour is formed by the decomposition of a portion of the silk or wool by means of the acid.

When the cloth is removed from the dye-beck it is submitted to several finishing processes, which vary according to the method of dyeing and the nature of the stuff. It is first carefully washed in water, to separate the coloured liquid which is mechanically attached to the cloth. It is usually dried at common temperatures, but occasionally in a well-ventilated apartment heated by steam pipes. Delicate colours are always dried in the shade.

A general idea of these finishing processes may be obtained from a notice of the treatment of cotton goods, after having been dyed with a vegetable infusion, with the intervention of a mordant.

As soon as the cloth is removed from the dye-beck, it is washed in two stone cisterns of cold water, each surmounted by a reel. It is next washed at a dashwheel; or if the action of this machine be too energetic, the *rinsing* or *washing machine*, Figs. 1 and 2, is used. The cloth still retains an excess of colouring matter, which cannot be removed by cold water; it is therefore next rinsed in a mixture of bran and boiling water, or in soap and water. This *clearing*, as it is called, is also in some cases performed by putting the cloth for a few minutes into a solution of chloride of lime.

After the clearing, all the water is expelled by squeezing rollers, or by a rotatory apparatus called the *water extractor*, Fig. 3. The wet cloth is put

into a compartment between two cylinders, and the apparatus made to perform 900 or 1,000 revolutions per minute; the water is driven out by the centrifugal force through the perforations in the cylinder, whence it flows away by a gutter or drain, and in a few minutes the cloth is nearly dry.

The cloth is next folded evenly, and passed, in a length of ten pieces, through the starching mangle; then through a steam drying machine, which consists of several hollow copper cylinders, each about 20 inches in diameter and 3 feet in length, filled with steam. Then comes the process of calendering, which has been already described under that head.

Indigo and madder are two of the most important dye-stuffs in use: the

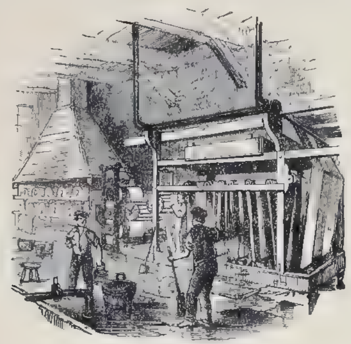


Fig. 1.

former came originally from India, under the name of *indicum*, and so little was known about it then that it was supposed to be mineral instead of vegetable. There are many varieties of indigo grown in the East and West Indies, Egypt, Arabia, and America, but always in the tropics. The plants are steeped and fermented, when the indigo is precipitated, the paste cut into cubical pieces and dried.

Madder is the product of the root of a trailing plant which is grown in

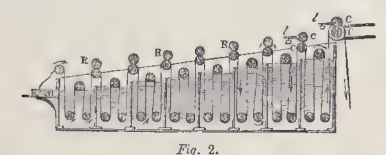


Fig. 2.

Italy, France, Switzerland, the Levant, Russia, and Holland, but it does not succeed well in this country. *Garancine*, which is made in France, is an extract of madder, and a few years since was largely imported here. Madder is a curious substance not very well understood, theoretically: it certainly has two kinds of colouring matter, red and fawn-coloured; the former yields Turkey red, the two together that peculiar colour used to dye the trousers of the French infantry, *garance*.

Madder has been almost dethroned of late by the analine and other

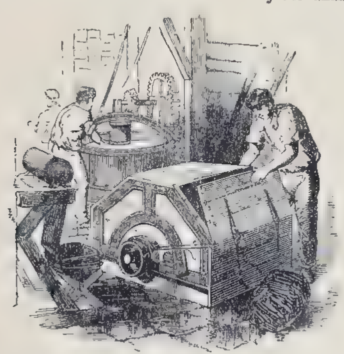


Fig. 3.

dyes; the extent of this rivalry will be seen by an extract from the official returns of imports, by which we find that the quantity of madder brought to this country has been as high as 128,000 cwts. per annum, and last year it only reached 25,000 cwts.; that of madder root has gone down from 300,000 to 33,000 cwts., and garancine from 79,000 to 15,000 cwts. a year.

Cochineal is a very important colouring matter. The imports of this curious natural product have amounted to 25,000 cwts. in a year. Carmine, the most beautiful colour we possess, and of which the use is extending in silk-dyeing and other processes, is a preparation of cochineal. The carmine made in France is considered superior to that produced in England, and the difference is attributed to the climate. The so-called rouge saucers, powders, and unguents for the skin, are made of all sorts of inferior and deleterious articles, such as benzoin, red sandal wood, alum, brandy, vinegar, &c., most of them positively mischievous.

Logwood, an important dye-wood, is found in large quantities in Campeachy and Honduras; it is of the same family as Brazil, Pernambuco, and Cam-wood. These woods are cut up into chips by means of a long fixed knife or a special machine, and sometimes ground into powder.

In the dyehouse logwood is used for the production of certain reds and blues, but its chief consumption is for blacks, which are obtained of various intensities by means of iron and alum bases.

The characteristic principle of logwood is called *hematine* or *hæmatoxyline*, and is best obtained by pulverising the watery extract of the wood as prepared for pharmaceutical use, mixing it with a portion of sand to prevent agglutination, and digesting the mixture with six or eight times its volume of ether; it should be frequently shaken, and after a few days the clear brown tincture poured off, and the greater part of the ether distilled from it; the residue is then mixed with water and left to spontaneous evaporation in a lightly covered basin. After some days, the hæmatoxyline crystallizes, and may be washed with cold water, and pressed between the folds of bibulous paper to free it from the mother liquor. The crystals are transparent, prismatic, of a brownish-yellow, and yield a pale yellow powder. As analyzed by Erdmann, hæmatoxyline in its anhydrous state contains $C_{40}\ H_{17}\ O_{15}$. Its solution is rendered colourless by sulphuric acid. Potash and ammonia render it dark purple-red, or if added in large quantity, they change it from violet to reddish brown or yellow. Baryta water, if added to a solution of hæmatoxyline in water deprived of air, first produces a white or pale blue precipitate, but this presently becomes blue, then red and brown. Chloride of tin gives a rose-coloured precipitate; alum a red colour without precipitation. The most sensible test of hæmatoxyline is pure or carbonated ammonia, which, under the influence of the air, reddens the smallest trace of it.

The bark of the sandal-wood also yields a fine red colouring matter. Nut-galls are excretions produced on oak-trees by a small insect. The best come from Aleppo and Smyrna; they are most valuable in black dyeing. Myrobalans, an Indian fruit, are used for the same purpose. Archil, orchil, or cudbear, is the product of several kinds of lichens, and has been used from a remote period as a dye-stuff; it yields a violet colour. In the dyeing of silks archil is frequently employed for lilac colours, hence their usually fleeting character; but with other hues this dye is merely used to modify or brighten, the silks being passed through a bath of archil to receive the peculiar bloom of that substance. The beauty imparted by this dye is a temptation to manufacturers to employ it too largely. Archil is employed with indigo in the woollen cloth manufacture, and produces a saving of indigo, while it gives a rich appearance to the blue or black cloth dyed with it; but this requires caution, and the bloom imparted is often deceptive. Archil cannot be made more durable by the ordinary means; a solution of tin appears to be the only substance capable of fixing it, and this changes the colour from violet to crimson.

Fustic, a dye-stuff, the *bois-jaune* of the French, is the wood of the *Morus tinctoria*, a large tree growing in Brazil, Jamaica, and most of the West Indian islands. A concentrated decoction of fustic deposits, on cooling, a yellow crystalline matter named *morine*. One part of fustic boiled in 10 of water for 15 minutes, gives a yellow decoction which gradually deposits morine. The decoction is inodorous, slightly astringent and bitter, and precipitates gelatine. With protochloride of tin, and with alum, it gives yellow precipitates; orange-coloured with acetate of lead; yellow-brown with acetate of copper, and dark olive with persulphate of iron. With sulphuric acid, it gives an orange-coloured precipitate, soluble in excess of the acid. It is reddened by nitric acid, and rendered paler by oxalic and by acetic acid. The yellow of fustic is said to produce several greens with indigo, with which it unites well.

Safflower is the product of a tree called *Carthamus tinctorius*, cultivated in India, Egypt, Spain, and other countries. The flowers are the only parts used in dyeing: these yield two sorts of colouring matter; the first yellow, and of little value; the second a pink of great delicacy and beauty, but not very permanent. The yellow colour of safflower is soluble in water, the pink is resinous in its nature, and is best dissolved by the fixed alkalies. The flowers of the carthamus are gathered, placed in a bag, and trodden under water to get rid of the yellow colour. They are then placed in a trough with soda, in the proportion of 6 lbs. to 120 lbs. of carthamus. After soaking for a time, the contents of the trough are transferred to another having a perforated bottom, but lined with a finely-woven cloth. This perforated trough is placed over an unperforated empty one, and water is poured through the upper one. This carries with it a large amount of the colouring matter released by the alkali. When the lower trough is full the bath is placed over another trough. A little more alkali is added,

and fresh water, until the latter runs through without carrying any more colouring matter. Lemon-juice is added to the dye-stuff in the troughs, and raises the colour to a bright cherry-red. Silk, in hanks, is then immersed and turned round skein-sticks in the bath as long as it will take up any colour. It is then dried, and if the colour be not deep enough, it is passed through another bath of similar strength. A final brightening is given by turning the silk round the skein-sticks seven or eight times in warm water with lemon-juice, in the proportion of half a pint to each pailful of water.

This colour will not bear the action of soap, nor will it long withstand exposure to the sun and air; it is chiefly employed on silk for imitating the fine dye of the French called *ponceau*. For *ponceau*, or flame-colour, the silk is first boiled, and then receives a slight foundation of annotto; but it must not be alumed.

Saffron is the brilliant-coloured stigmata of the blue crocus, but it is not much used now in dyeing. Annotto, Annotta, or roucou, is a red colouring matter obtained from a plant called *Bixa Orellana*, cultivated so largely in the West Indies, on the banks of rivers, as to give its name to whole districts: one instance of this is Annotto Bay, in Jamaica. The colour is from a soft thick rind which surrounds the seed pod, a thick extract of which is made up for commerce in the form of cakes and balls, weighing two or three pounds each. Dyers make from it a reddish colour which they call aurora, and what is sold as "Nankin dye" is a solution of annotto in potash and water. The consumption of annotto is considerable. Quercitron is the inner bark of the yellow oak of North America; its colouring principle, quercitron, forms pale yellow spangles; it is soluble in alcohol, and partially so in water. A decoction of the bark, deprived of its tannin by means of glue, produces a fine yellow dye with alum, and various shades of olive with iron mordants. Quercitron is largely used in calico-printing. Turmeric is a well-known substance, from which a valuable extract called curcumine is obtained. This, treated with acids, alkalis, and water, gives reddish brown and pale green dyes.

Amongst other dye-woods and stuffs may be mentioned catechu, an extract from Indian palm trees; gambier, another extract from Oriental trees, called sometimes Terra Japonica; the wood of the barberry, or *épine vinette;* Nicaragua and Japan wood; walnut husks; wild or dyer's weed; woad, saw-wort, hulls of divi-divi, roucou seeds, buckthorn berries; *avelanèdes*, or hairy filberts; kermes, an insect which feeds on oak, and a mineral of the same name; Indian lac-dye; dulcamara, or bitter-sweet; prussian blue, and a hundred other substances of more or less importance.

Of the three primitive colours blue is the least common amongst colouring matters; a green is obtained from the berries of the buckthorn, and an inferior kind from those of the privet, while the Chinese have from time immemorial obtained a perfect green from the leaves of the buckthorn by a process which was a secret until a few years ago: the same green colour was obtained by a practical chemist of high reputation, the late M. Persoz, of Paris—a valuable discovery, but soon superseded by aniline green, which possesses the same good qualities, great brilliancy, and appearing the same by artificial as by sunlight, and further, not having the poisonous character of the arsenical greens. It should be observed that many substances contain two distinct kinds of colouring matter. The multiplicity of the possible combinations of such a mass of colouring matter —metallic, acid, and alkaline agents—may easily be conceived.

Dyeing includes a number of most complicated chemical processes, and he who is no chemist can never be anything more than a plodding dyer, he must always tread in the footsteps of the scientific man. On the Continent schools of art and science and colleges of industry have produced a class of thoroughly sound scientific manufacturers; we can boast of many who have made themselves so by their inherent talent, perseverance, and energy, but the majority have, unfortunately, little to guide them but that which is called the rule of thumb. However, matters have mended greatly in this respect during our time, and the rate of progress we like to believe is on the increase. In the lecture by Dr. Lyon Playfair on the chemical principles involved in manufactures, &c., from which we have already extracted one short passage, we find a capital illustration of what the chemist has done for the calico-printer. Lapis-lazuli, it is well known, yields a beautiful blue colour, known as ultramarine, still used by artists, but it was enormously dear, so as to be quite out of the reach of the calico-printer; the precious stone was carefully analyzed, and an artificial ultramarine produced at three or four shillings per pound; but it was not soluble, and how to fix it on the fabric was the puzzle; at last it was suggested that the colouring matter might be mixed with albumen, which, being coagulated by means of heat, would fix the colour. Dried white of eggs was used for the purpose by barrelfuls; but it was again suggested that cheese might have the effect; and now the artificial ultramarine is fixed by means of cheese made chiefly from Scotch buttermilk, and dissolved in ammonia. This cheese is sold under the name of *lactarine*. We recommend the student to read carefully the whole of the two series of lectures, in one of which Dr. Playfair is comprised; they form only a moderate-sized octavo volume.

At the first Great Exhibition a number of new colours made their appearance, and attracted great attention; these were what have since been known as coal-tar, or aniline colours, which have effected a most extraordinary revolution in the processes of dyeing. These colours, we believe, were due to the experiments made by Dr. Hofmann, who gave a lecture on the subject at the Royal Institution of London in 1862.

The substance known as gas-tar had become a terrible burden to the gas companies; they could find no market for it, and the quantity being enormous, to get rid of it was almost impossible, and the cost of storing extremely heavy and rapidly increasing. The chemists took up the subject, and found that coal-tar oil contained three principles, to which the names of *aniline*, *benzol*, and *phenol* were given, with properties very peculiar to each.

Each of these three coal-tar oil constituents is of importance in the arts. Benzol is the most convenient solvent for caoutchouc, and as an agent for removing oil and grease; phenol, when treated with nitric acid, affords a beautiful yellow dye known as *carbazotic acid;* while aniline is the source of the favourite *mauve* and *magenta* dyes.

The amount of aniline in coal-tar is very limited, but fortunately benzol, the phenylated hydrogen, may readily be converted into aniline, the phenylated ammonia. For example, benzol is readily attacked by fuming nitric acid, which in dissolving produces a liquid of a beautiful red colour; on the addition of water this liquid deposits a heavy yellow oil, collecting at the bottom of the vessel, perfectly different from benzol, which floats on the surface of the water. The tar was treated with hydrogen, carbon, and many other chemical agents, and the results have been most extraordinary.

New discoveries and improvements are still going on, but we trust that what we have given will convey a pretty clear idea of what chemistry has done for dyeing in our own generation. The accounts read like a fairy story or a necromancer's tale, but they have no romance but that which belongs to science; the material results surpass anything in our experience. Every shop that deals in textile goods of any kind will supply examples of aniline colour, but the most startling proofs of the results of these chemical conversions of gas-tar into brilliant pigments have been shown at our Exhibitions, when specimens of dyed silks have been shown of innumerable tints of almost every colour in the prism.

One of the products of the distillation of coal-tar at a high temperature is naphthalin, which is still a burden to the gas companies: beautiful colours have been produced from it, but they cannot be fixed, they are completely fugitive; perhaps another great chemical triumph will result in the solution of this problem.

When silk or wool is dyed with aniline colours no mordant is required, and, consequently, the operation becomes simple; the solutions are made with alcohol or acetic acid. In the dyeing of vegetable matters, cotton, linen, &c., tannic acid, albumen, gluten, and other mordants are used.

At first aniline colours were high-priced, but they have now become much cheaper: aniline which originally sold at 14*s*. is now about 1*s*. per lb., solutions of mauve and magenta which cost £6 per gallon now vary in price from 6*s*. to 16*s*., and aniline blue, originally charged at the rate of £11 per lb., is now worth less than £2.

No. 15.—PRINTING AND BLOCK AND ROLLER ENGRAVING.

N old times the only means of decorating woven fabrics were embroidery and other needle-work and actual painting. We have in the preceding pages shown the gradual development of the loom, from the rude apparatus of the Indian to the figure-weaving with the aid of a drawboy, to the Jacquard apparatus, the adoption of steam in place of hand-labour, and, lastly, the crowning wonder, the application of the Jacquard to the power-loom and the lace-making machine, by means of which the most intricate patterns are produced with almost unerring exactitude and with a marvellous rapidity that look like magic. Second only to figure-weaving in its importance and its history, we must place printing or decoration by colour. Painted cloths for wall hangings were probably produced earlier than tapestry, but in them the tissue was merely the support, just as canvas is to a picture, the tissue forms no part of the real work: in the decoration of woven fabrics the case is different, then the bleached or dyed surface of the silk, cotton, or woollen forms the true ground and the printed ornamentation becomes decoration. As in the case of wall-papers, the first patterns of the kind produced were painted by hand. We see occasionally paintings of this class on a small scale on silk and velvet for hand-screens or other small articles, but they present but little art or interest of any kind.

Naturally as soon as patterns were produced on paper by means of wood blocks carrying colour, the application of the same process to woven fabrics came about naturally, but printing on paper is nothing but a mechanical transfer of the pigment employed from the block to the paper: in calico printing, on the contrary, the process is often complex, including both printing and dyeing; that is to say, the pattern is wholly or partially printed with mordants, and then the fabric is dyed in the ordinary manner and the various colours produced.

The art of producing a coloured pattern on cloth by the application of colouring substances appears to be of great antiquity. Homer notices the variegated linen cloths of Sidon as magnificent productions, and Herodotus says that the inhabitants of Caucasus adorned their garments with figures of animals, by means of an infusion of the leaves of a tree, and that the colours thus obtained were durable. Pliny's description of the art as practised by the ancient Egyptians is almost identical with the modern processes. He says:—"They take white cloths, and apply to them not colours, but certain drugs which have the power of absorbing or drinking in colour; and in the cloth so operated on, there is not the smallest appearance of any dye or tincture. These cloths are then put into a cauldron of some colouring matter, scalding hot, and after having remained a time are withdrawn all stained and painted in various colours. This is, indeed, a wonderful process, seeing that there is in the said cauldron only one kind of colouring material; yet from it the cloth acquires this and that colour, and the boiling liquor itself also changes according to the quality and nature of the dye-absorbing drugs which were at first laid on the white cloth. And these stains, or colours, moreover, are so firmly fixed as to be incapable of being removed by washing. If the scalding liquor were composed of various tinctures and colours, it would doubtless have compounded them all in one upon the cloth; but here one liquor gives a variety of colours according to the drugs previously applied. The colours of the cloths thus prepared are always more firm and durable than if the cloths were not dipped into the boiling cauldron." In India the art of calico-printing has been practised for ages, and it derives its English name from *Calicut*, a town in the province of Malabar, where it was formerly carried on extensively. The cotton chintz counterpanes, called *palampoors*, which from an early period have been made in the East Indies, are prepared by placing on the cloth a pattern of wax, and dyeing the parts not so protected. Cortez noticed in Mexico that the inhabitants wore garments ornamented with coloured figures. The North American Indians have also been long acquainted with the art of applying different coloured patterns to cloth.

The art of calico-printing was practised in Asia Minor and the Levant several centuries before its introduction to Europe. It was not till the close of the seventeenth or the beginning of the eighteenth century that Augsburg became celebrated for its printed cottons and linens, and that city was long a school for the manufacturers of Alsace and Switzerland. The art was introduced into England, about the year 1676, by a Frenchman, who established works on the banks of the Thames, near Richmond. More extensive works were established soon after at Bromley Hall, in Essex.

In the middle of the last century only 50,000 pieces of the mixed cloth were printed each year in Great Britain, whereas, at the present time, a single manufactory will turn out six or eight times that quantity in the course of a year. About the year 1774, when Arkwright's machinery was producing calico with such wonderful facility, the legislature repealed the unjust law which prohibited the wearing of printed calico made entirely of calico, imposing, however, upon it a duty of 3*d.* per square yard, which was raised in 1806 to 3½*d.*

As printed calicoes and cottons formed an important article of dress with nearly all the community, especially the lower, the continuance of this heavy duty was felt to be a great hardship, and interfered also with attempts to improve the art. Moreover, the actual revenue obtained from this source was but small, after deducting drawbacks on exports, and the expenses of collection. Thus in the year 1830 a revenue of £2,280,000 was levied on 8,596,000 pieces, of which, however, about three-fourths were exported with a drawback of £1,579,000, and deducting the expenses of collection, the sum of £350,000 only found its way into the exchequer. In the year 1831, the duty was wholly repealed, to the great advantage both of manufacturer and consumer; and since that time the art has been carried to a wonderful state of perfection, both chemically and mechanically. Printed goods which half a century ago were sold for 2*s.* 3*d.* per yard, may now be had for 8*d.* or less; and a cotton print, sufficient to make a complete dress, may be had for 3*s.* or 4*s.*, or less. It is stated by Mr. M'Culloch, as an example of the prodigious increase of calico-printing, that in 1829, before the abolition of the duty, 89,862,433 yards of all descriptions of printed goods were exported; whereas in 1841, there were exported of printed cottons alone 329,240,892 yards, of the declared value of £7,772,735.

The object of calico-printing is to apply one or more colours to particular parts of cloth, so as to represent a distinct pattern, and the beauty of a print depends on the elegance of the pattern and the brilliancy and contrast of the colours. The processes employed are applicable to linen, silk, worsted, and mixed fabrics, although they are usually referred to cotton, cloth, or calico.

There are various methods of calico-printing, the simplest of which is block-printing by hand, in which the pattern or a portion thereof is engraved in relief upon the face of a block of sycamore, holly, or pear-tree wood, backed with deal, and furnished with a strong handle of box-wood. The block, Fig. 1, varies in size from 9 to 12 inches long, and from 4 to 7 inches broad. In some cases the pattern is formed by the insertion into the block of narrow slips of flattened copper, the interstices being filled with felt. This gives a very distinct impression. The block is charged with colour by pressing it upon a surface of woollen cloth stretched tightly over a wooden drum. This, which is called the *sieve*, is made to float in a tub of size or thick varnish, for the purpose of giving it elasticity. The sieve is covered with the colouring matter by a child called the *tearer* (probably from the French *tireur*), who takes up with a brush a small quantity of the colour from a pot, and spreads it uniformly over the surface of the sieve, and every time that the man presses his block upon the sieve in order to charge it with colour, it is the duty of the tearer to brush over the woollen surface in order to erase the mark of the block, for if this were not done the block would not be equally charged with colour.

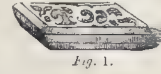


Fig. 1.

The calico having been prepared for printing by *singeing*, *bleaching*, and *calendering* [see BLEACHING and CALENDERING], a number of pieces are stitched end to end, and lapped round a roller, or arranged in folds in the printing-shop, which is a well-lighted apartment, the air of which is kept warm in order to dry the colours soon after they are applied, for which purpose the cloth is passed over hanging rollers, so as to expose a large surface. The printing-table, Fig. 2, is about 6 feet long, and is made of mahogany, marble, or flagstone, or any material capable of forming a flat hard surface. This table is covered with a blanket, upon which the calico is spread, and the block being charged with colour as above described, the man applies it to the cloth in the exact spot required, and in some cases strikes it on the back with a wooden mallet, in order to transfer the impression fully. Thus by repeated applications of the block, a pattern is produced in one colour. Care is required to place the block in the exact spot, so as to make one impression exactly join or fit in with the previous impression, and for this purpose the block is furnished with small pins at the corners, which make holes in the cloth, and serve as a guide to the printer. If the pattern contain

three or more colours, there must be as many blocks, all of equal size, the raised portions in one, which take up colour, corresponding with depressed portions in the others which do not take up colour. In order therefore to print a piece of cloth 28 yards long, and 30 inches broad, with three blocks, each measuring 9 inches by 5, there must be 672 applications of each. But if the design consist of parallel stripes of different colours, they may be applied with one block at a single application on the same part of the cloth, by arranging the colours in small tin troughs, and transferring a portion



Fig. 2.

from them to the sieve by means of a small wire brush, and the colour is then distributed evenly in stripes over the surface by a roller covered with woollen cloth. In those patterns in which the colours are blended into one another at the edges, in what is called the *rainbow style*, they are first blended by a brush on the sieve before being taken up by the block. Stereotyping has been applied to the production of printing blocks. A small mould is produced from a model of the pattern, and copies are then made by pouring fusible metal into it. A number of these plates are joined together and mounted on a stout piece of wood, and thus form a printing-block.

A machine called the *Perrotine*, in honour of its inventor, M. Perrot, of Rouen, is in use in France and Belgium as a substitute for hand-block printing. It is thus described by Dr. Ure:—"Three wooden blocks, from 2½ to 3 feet long, according to the breadth of the cloth, and from 2 to 5 inches broad, faced with pear-tree wood, engraved in relief, are mounted in a powerful cast-iron frame-work, with their planes at right-angles to each other, so that each of them may, in succession, be brought to bear upon the face, top, and back of a square prism of iron covered with cloth, and fitted to revolve upon an axis between the said blocks. The calico passes between the prism and the engraved blocks, and receives successive impressions from them as it is successively drawn through by a winding cylinder. The blocks are pressed against the calico through the agency of springs, which imitate the elastic pressure of the workman's hand. Each block receives a coat of coloured paste from a woollen surface, smeared after every contact with a mechanical brush. One man, with one or two children for superintending the colour-giving surfaces, can turn off about 30 pieces English per day, in three colours, which is the work of fully 20 men and 20 children in block-printing by hand."

Copper-plate printing similar to that used in the production of engravings has also been applied to calico-printing, but the perfection to which cylinder-printing, next to be described, has been brought, rendered the extension of this method unnecessary.

The invention of *cylinder* or *roller-printing* is the greatest achievement that has been made in the art, producing results which are truly extraordinary: a length of calico equal to one mile can by this method be printed four different colours in one hour, and more accurately and with better effect than block-printing by hand. One cylinder machine, attended by one man, can perform as much work in the same time as 100 men attended by 100 tearers. The effect of this beautiful machine has been greatly to cheapen cotton prints, and to create an enormous demand for them, both for the home and the export trade, so that while apparently superseding labour in one direction, it creates a demand for it in all directions.

The invention of this machine is attributed to two persons who had no connection with each other: the one was a Scotchman named Bell, who about the year 1785 practised at Monsey, near Preston; the other was named Oberkamf, a calico printer at Jouy, in France. We will endeavour, with the assistance of a diagram, to explain the principle of the machine as arranged for printing a pattern in three colours. The cylinders upon which the pattern is engraved, one cylinder for each colour, are shown in section at *c*, Fig. 3, and a view of one of them in Fig. 4. Each cylinder is mounted on a strong framework, so as to revolve against two other cylinders D and *e*: the cylinder *e* is covered with woollen cloth, and dips into a trough *i*, containing the colouring matter properly thickened, so that as *e* revolves it takes up a coating of colour and distributes it over the engraved roller *c*. D is a large iron drum covered with several folds of woollen cloth, so as to form a somewhat elastic printing surface; an endless web of blanketing *a a* is made to travel round this drum, which serves as a sort of guide, defence, and printing surface to the calico *b b* which is being printed. Now it is obvious from this arrangement, that the cylinder *e* in revolving must spread the colour uniformly over the engraved cylinder *c*, whereas it is wanted only in the depressed or engraved parts; the excess of colour has therefore to be removed before the roller comes in contact with the calico, or instead of being ornamented with

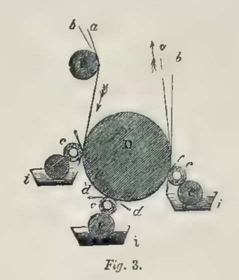


Fig. 3.

a pattern it would be disfigured with an unmeaning patch of colour. The superfluous colour is removed by a sharp-edged knife or plate *d*, usually of steel, called the *doctor*. This is so arranged that the colour scraped off shall fall back into the trough *i*. Each engraved cylinder is usually provided with two doctors, one called the *colour doctor*, *d*, and the other the *lint*

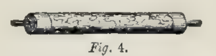


Fig. 4.

doctor, *d'*. The object of the latter is to remove the fibres which the roller acquires from the calico. Doctors are made of gun-metal, bronze, brass and iron alloys, as well as of steel, that metal being used which is the least acted on by the colouring materials and mordants used in the troughs.

Fig. 5 is a view of a cylinder machine for printing colours. It has been

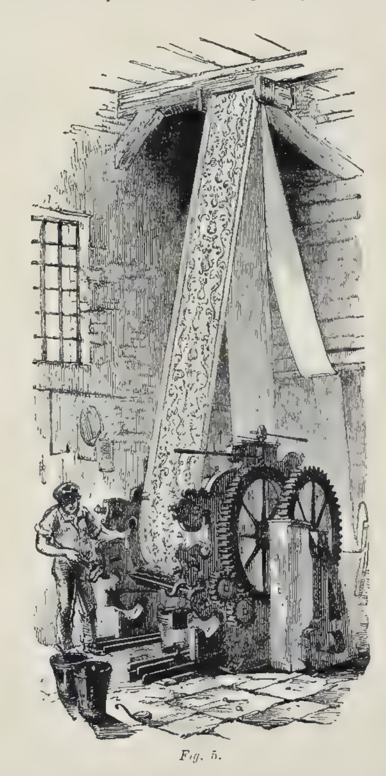


Fig. 5.

engraved from a sketch made by Mr. Prior, in the well-arranged print-works of Mr. Joseph Lees, of Manchester. Some of the machines are very complicated in appearance, as many as eight colours being printed at once by one machine; but this complication is only apparent, for it is produced by the repetition of similar arrangements eight times over, each engraved roller,

provided with its own colour trough, &c., revolving against the iron drum D; but very great nicety of arrangement is required to bring all these rollers to bear upon the cloth so as to print at the exact spots required for forming a complicated pattern; but when the proper adjustment is made, a machine for printing eight colours acts with as much precision and regularity as a machine arranged for a fewer number of colours.

As fast as the calico is printed, it is drawn through a long gallery or passage, raised to the temperature of nearly 200° by means of a furnace flue which traverses its whole length. The upper surface of the gallery is covered with rough plates of cast-iron, which radiate heat upon the printed goods. A piece of calico of 28 yards is drawn through the gallery in about two minutes, during which the colours become dried and set.

The printing cylinders vary in length from 30 to 40 inches, according to the width of the calico: the diameter varies from 4 to 12 inches. Each cylinder, A, Fig. 6, and in section C, is bored through the axis *d d*, and

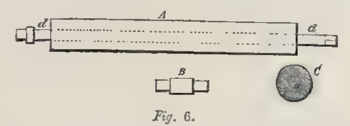


Fig. 6.

accurately turned from a solid piece of metal. For some styles of pattern the engraving is done by hand, but as this is expensive, it is usual to adopt Perkins's method of tranferring engravings from one surface to another by means of small steel rollers, B. The pattern is first drawn upon a scale of about 3 inches square, so that this size of figure being repeated a number of times will cover the printing cylinder. The pattern is then engraved upon a roller of soft steel about 1 inch in diameter, and 3 inches long, so as to occupy its surface exactly. This small roller, which is called the *die*, is next hardened by heating it to redness and suddenly quenching it in cold water. The roller thus hardened is then put into a rotatory press, and made to transfer its design to a similar small roller in a soft state, called the *mill*. The design which was sunk in the die now appears in relief on the mill. The mill in its turn is hardened, and being put into a rotatory press, engraves or indents upon the large copper cylinder the whole of the intended pattern. This is of course a work of time, and requires considerable care to make the numerous junctions of the small roller exactly fit each other upon the printing cylinder. By this process, however, a pattern may be imparted to a large cylinder at the cost of about £7, while if engraved by hand it might cost seven or eight times that sum. By the method just described, a worn cylinder can be renewed and made equal to a new one. The pattern is also sometimes produced by *etching*, in which case the cylinder is covered with a thin coat of varnish, and on this the pattern is traced with a diamond or steel point. Aquafortis is then applied to the surface, which bites into or corrodes the parts which have been removed by the point. This point or tracer is sometimes applied in a manner similar to that of the eccentric chuck of a lathe, by which means the surface is covered with patterns, or a ground-work for patterns, of great variety and beauty. Eccentrically engraved cylinders are exported from Manchester, and the foreign printer adds the pattern. The cost of a copper cylinder before engraving varies from £5 to £7, and the cost of engraving from £5 to £10. The electrotype process has also been used for producing the design on the printing cylinder. The design is also sometimes cut in relief upon wooden rollers; or formed by the insertion of flat pieces of copper edgeways. This is termed *surface printing*; a combination of wooden and copper rollers forms what is called the *union printing machine*.

Another method of calico-printing remains to be described, namely, *press-printing*, by which several colours can be printed at once. The cloth to be printed is wound upon a roller at one end of the machine, and the design, which is formed in a block of mixed metal about $2\frac{1}{2}$ feet square, is supported with its face downwards in an iron frame, and can be raised or lowered at pleasure. The face of the block is divided into as many stripes, ranging crossways with the table, as there are colours to be printed. If, for example, the pattern be made up of five stripes of different colours, and each stripe be 6 inches broad, and as long as the breadth of the cloth, the colours have to be applied without mingling or interfering with each other. This is accomplished in the following manner:—The side edges of the table are furnished with a couple of rails similar to a railway, and upon this is a shallow tray or frame capable of moving backward and forward upon wheels. Within this frame is a cushion of about the same size as the printing-block, and by its side are five small troughs containing the thickened colours. By means of a long piece of wood, formed so as to dip into all the troughs at once, the tearer applies a small portion of each colour to the surface of the cushion, and spreads them evenly into five portions or stripes, taking care not to mix them; but making their breadth equal to that of the stereotype rows on the block. The cushion being prepared, the frame is rolled along the railway until it is immediately under the printing-block, which the pressman then lowers upon the cushion, by which means the five stripes of the block become charged each with its proper colour. The block is then raised, the frame rolled away, and the block brought down upon the cloth, which it prints with five rows of different colours. On raising the block, the cloth is drawn forward about six inches in the direction of its length, or exactly the width of one stripe on the block; the tearer again pushes forward the cushion with the colours renewed, and the block is again charged and applied to the cloth. Now, as a length of the cloth equal to the width of a stripe is drawn from under the block at each impression, every part of the cloth is brought into contact with all the stripes on the block. Great care is required so to adjust all the moving parts of the press, that the colours may not mingle and distort the pattern.

Having thus briefly described the chief mechanical processes of calico-printing, we come now to notice the chemical. The colours used in calico-printing are derived from all the three kingdoms of nature, but it seldom happens that solutions, infusions, or decoctions of these colours admit of being applied at once to the cloth without some previous preparation, either of the cloth itself or of the colouring material. It is often necessary to apply some substance to the cloth which shall act as a bond of union between it and the colouring matter. This substance is usually a metallic salt, which has an affinity for the tissue of the cloth as well as for the colouring matter when in a state of solution, and forms with the latter an insoluble compound. Such a substance is called a *mordant* (from the Latin *mordere*, to bite), a term given by the French dyers under the idea that it exerted a corrosive action on the fibre, expanding the pores and allowing the colour to be absorbed. The usual mordants are common alum and several salts of alumina, peroxide of iron, peroxide of tin, protoxide of tin, and oxide of chrome. These have an affinity for colouring matters, but many of their salts have also a considerable attraction for the tissue of the cloth, which withdraws them to a certain extent from their solutions. Mordants are useful for all those vegetable and animal colouring matters which are soluble in water, but have not a strong affinity for tissues. The action of the mordant is to withdraw them from solution, and to form with them, upon the cloth itself, certain compounds which are insoluble in water.

In calico-printing it is generally necessary to bring the mordant or the colouring matter into such a state of consistency as to prevent it from spreading beyond the proper limits of the design. This is done by the use of *thickener*, the most useful of which are wheat-starch and flour; but many others are used, such as gum-arabic, British gum, high-dried potato starch, gum-Senegal, gum-tragacanth, jalap, pipe-clay, or China-clay mixed with gum, dextrine, potato and rice starch, sulphate of lead mixed with gum, and many others. The choice of proper thickeners requires attention; for two similar solutions of the same mordant equally thickened, but with different thickeners, may give different shades of colour when used with the same colouring material.

The colours, with the proper thickeners, &c., are prepared in vessels furnished with steam-jackets, as shown in Fig. 7, for raising the contents to the required temperature.


Fig. 7.

Although the different methods of printing are numerous, and the combinations of colours and shades of colours almost infinite, yet each colour in a pattern must, in the present state of the art, be applied by one of six different *styles* of work. These are termed: 1, the madder style; 2, printing by steam; 3, the padding style; 4, the resist style; 5, the discharge style; and 6, the China-blue style. By the proper combination of two or more of these styles any pattern, however complicated, is produced.

The madder style is so called from its being chiefly practised with madder; but it is applicable to most soluble vegetable and animal colouring matters. The first process in this style is to print the calico with a mordant; that is, instead of printing at once with colour, the parts of the surface which are to have a madder colour imparted to them are first impressed with a mordant. After the calico has passed through the hot flue, it is in many cases suspended free from folds for one or two days in what is called the *ageing-room*, where by exposure to air the mordant, or a portion thereof, undergoes a chemical alteration, whereby it becomes attached to the cloth in an insoluble state. Any portion of the mordant that remains in a soluble

state must be completely removed, or the colour in being subsequently applied would spread over the surface, instead of being confined within the limits of the pattern. The superfluous mordant is then removed by passing the dried calico through a warm mixture of cow-dung and water. This is called *dunging*. The mixture is usually contained in two stone cisterns, placed end to end, each about 6 feet long, 3 feet wide, and 4 feet deep. The mixture in one cistern is formed with about 2 gallons of dung to the cistern full of water, heated to about 160° or 180°. The second cistern contains about half this quantity of dung. The calico, guided by rollers to keep it free from folds, is drawn quickly through the first trough, and then immediately through the second. It is then washed in clean water in what is called a wince-pit, and again in a dash-wheel. Dunging is further useful in removing the thickening paste by which the mordant is applied, and it also determines a more intimate union between the mordant and the fibre of the cloth. The process is necessary for alum, iron, and tin mordants, when applied to the cloth before the colouring matter.

The difficulty of procuring cow-dung in sufficient quantities has led to attempts to find substitutes in those chemical substances which an analysis of dung indicate as the essential ingredients. Thus a solution of phosphate of soda and phosphate of lime, with a little glue or some other form of gelatine, has been used under the name of *dung-substitute*, or simply *substitute*.

After washing in cold water, the mordanted cloth is rinced in a weak solution of substitute and size. It is then ready for the colour. This is not applied by the process of printing, but simply by drawing the cloth for two or three hours through a solution of colouring material. The colour attaches itself permanently to those portions of the cloth to which the mordant has been applied, and forms a true chemical compound therewith; but on the unmordanted portions the colour is feebly attached, and is subsequently removed by washing in soap and water, or in bran and water, or in a dilute solution of chloride of lime. This last washing is called *clearing*.

Such is a very meagre outline of the most important processes concerned in printing and dyeing a piece of calico according to the madder style. The processes actually required for finishing a piece of cloth are numerous, as, for example, in producing a red stripe upon a white ground, the bleached cloth is submitted to nineteen operations, as follows:—1, printing on mordant of red liquor (a preparation of alumina), thickened with flour, and dyeing; 2, ageing for three days; 3, dunging; 4, rincing in cold water; 5, washing at the dash-wheel; 6, rincing in dung-substitute and size; 7, rincing in cold water; 8, dyeing in madder; 9, rincing in cold water; 10, washing at the dash-wheel; 11, rincing in soap-water containing a salt of tin; 12, washing at the dash-wheel; 13, rincing in soap-water; 14, rincing in a solution of bleaching-powder; 15, washing at the dash-wheel; 16, drying by the water extractor; 17, folding; 18, starching; 19, drying by steam.

The operations of washing and drying are very important, and provision is made for them on a very complete scale. The pieces of cloth are brought down into water-tanks, passing under and over rollers, furnished with balance-weights to keep the calico stretched: these weights can be adjusted on their levers, so as to vary the tension to any degree required. In some cases the bottom of the tank is supplied with water in jets, so that the calico is subjected to the dashing action of the water. In passing out of the washing machine, the calico is received on a skeleton roller, where it is smoothed by an attendant, and passes from this to the drying cylinders.

In another form of washing-machine the cloth is arranged in folds upon a shelf, whence it is guided by rollers into the first vat or division of the machine: it then passes out between rollers, which press out the water and thus make it again absorbent, before passing into the second division: it proceeds in this way until it arrives at the seventh division, where the rollers are pressed together with weighted levers, and the calico leaves the machine with most of its moisture pressed out. The object of having the divisions of unequal height is to establish a current of water; for the tallest vat being first supplied, overflows into the next, and this into the third from the right, until the collected overflowings escape by the lowest vat. In this way a current is kept up, and the calico, moving in a contrary direction to that of the current, is completely washed.

The second style of calico-printing is by steam. The colours which attach themselves firmly to the cloth by being printed on it with a mordant are not numerous, but by exposing the goods so printed to the action of steam, an intimate combination takes place between the tissue, the colouring matter, and the mordant. The mechanical arrangements for steaming are various. In some works the cloth is suspended free from folds in a small chamber of masonry, into which steam is admitted. In other works the goods are placed in a large deal box, the lid of which is made nearly steam-tight by edges of felt, and the steam is admitted through a pipe perforated with a multitude of small holes, which traverses the box. But the common method is to coil the calico round a hollow copper cylinder, A, Fig. 8, perforated with holes, the lower end of which is connected with a steam-pipe. The cylinder is prepared by mounting it in a horizontal position in a frame. A roll of blanket is first lapped round it, then a piece of white calico,

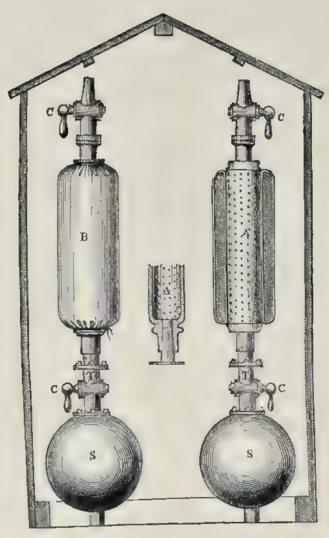


Fig. 8.

and lastly three or four pieces of the printed and dried calico stitched end to end. The cylinder is then fixed upright in a small apartment furnished with a chimney to carry off the steam. The open end of the cylinder is screwed to a pipe connected with the spheres S S, which are supplied with steam from the main boiler of the works, the quantity being regulated by a stop-cock C. The temperature is kept at 211° or 212° to prevent much condensation, which makes the colours run. A higher temperature is injurious, but a slight condensation is required to keep the goods moist. The steaming is carried on for from 20 to 40 minutes, according to the nature of the colour. When the steam is cut off, the cloth is unrolled immediately, to prevent condensation. On exposure to the air, the thickening material soon solidifies, and the goods become dry and stiff. The cloth is then aged for a day or two, and the thickener gently washed out with cold water.

The operation of steaming not only attaches the colour firmly, but it gives a brilliancy and delicacy of finish. It is not always adopted, for some colours become firmly attached to the cloth by mere exposure to air. A variety of cheap goods for some of the foreign markets are printed in *fugitive* colours; these not being fixed by steaming or a mordant are called *spirit*, *fancy*, or *wash-off* colours.

The third style, called the *padding style*, applies to mineral colours only. By this means a pattern may be produced on white or coloured ground, and a ground may also be formed for the design in other colours. For the latter purpose the *padding-machine* is used. This is almost identical with the starching mangle described in CALENDERING, the trough containing the thickened colouring matter instead of starch. A roller covered with blanket dips partly into the trough, and above and in contact with this is another roller, and the cloth to be padded passes between the two. When the cloth is uniformly imbued with the colour, it is dried at a temperature of 212°. If the colour is to be applied to the face of the cloth only, the common printing-machine with a roughened roller is used instead of the padding-machine. The ground is sometimes produced by the union of two colours in solution forming within the fibre of the cloth itself an insoluble coloured precipitate. For this purpose the cloth is first passed through one coloured solution and then dried. It is next passed through the other coloured solution; the two then react upon each other and produce the desired effect. Or the cloth may be padded in one solution, and afterwards winced in the other. In order to produce a design on a white or coloured ground, the cloth is printed with one of the solutions, and then padded or rinced in the other.

In the next style of printing, the *resist style*, the white cloth is printed with a *resist paste*, the object of which is to prevent those portions of the cloth to which it is applied in the form of a pattern from taking up colour when the cloth is passed through the dye-beck. A white design on a coloured ground is a simple example of this style. There are two classes of resists, one to prevent a mordant from attaching itself to the portions of the cloth so protected, and the other to shield the cloth from colouring matter. Some resists act mechanically; such are *fat* resists. Others act chemically as well as mechanically.

The object of the fifth or *discharge style* is to produce a white or coloured figure upon a coloured ground. For this purpose the dyed or mordanted cloth is printed with a substance called the *discharger*, which acts either on the colouring matter or on the mordant before the cloth is exposed to the dye. The discharger acts by converting the colouring matter on the mordant into colourless or soluble products, which may thus be removed so as to allow the part thus discharged to be dyed in another colour. A vegetable or animal colouring matter is usually discharged by chlorine and chromic acid; and a mordant is dissolved by an acid solution.

By this style are produced the well-known imitations of Bandana handkerchiefs, in which white figures are formed on a ground of Turkey-red by means of an aqueous solution of chlorine. This is made to flow down through the red cloth at certain points, which are defined and circumscribed by the pressure of hollow lead types inserted into plates of lead contained in a hydraulic press. The press is furnished with a pair of pattern plates, one attached to the upper block of the press, and the other to the movable part or sill. From twelve to fourteen pieces of cloth previously dyed in Turkey-red are stretched over each other as evenly as possible, and then rolled round a drum. A portion of the fourteen layers equal to the area of the plates being drawn through between them, the press is worked, and the plates are brought together with a force of upwards of 300 tons. The solution of chlorine is then allowed to flow into the hollows of the upper lead plate, whence it descends on the cloth and percolates through it, extracting the Turkey-red dye, the intense pressure preventing the bleaching liquor from spreading beyond the limits of the figures perforated in the plates. When a certain quantity of bleaching liquor has passed through, water is admitted in a similar manner to wash away the chlorine. The pressure is then removed, and another square of the fourteen layers is moved forward under the plates, and the process is repeated. When all the pieces have been discharged they are rinced in water, and further treated so as to improve the lustre both of the white and of the red.

The sixth and last style of printing is for *China-blue*, a peculiar style practised with indigo only, two or three shades of colour being commonly associated with white. The bleached calico is printed of the required pattern with a mixture of indigo, orpiment, sulphate of iron, gum, and water. It is then aged for a day or two, and afterwards stretched in perpendicular folds on a rectangular frame of wood, Fig. 9. This is immersed in a certain order in three liquids, contained in stone cisterns the tops of which are on



Fig. 9.

a level with the ground: 1, in milk of lime; 2, in a solution of sulphate of iron; 3, in a solution of caustic soda. The frames are dipped several times alternately into the first and second cisterns, with exposure to the air for a short time between each dip: they are not dipped so frequently into the third cistern, but the dipping into this follows immediately after that in No. 2. By these operations, the insoluble indigo which has been applied to the surface becomes converted into soluble indigo or *indigotin* [see DYEING], which is dissolved and transferred to the interior of the fibres, where it is precipitated in the original insoluble form.

In calico printing, as in all branches of textile manufacture, the grand difficulty is to have a constant succession of novelties; each summer and each winter must have its new patterns, however good were those of last summer and last winter; novelty is the only food with which fashion is satisfied. Old patterns are sent abroad, but at home, and also for the foreign trade, new must be provided. One difficulty connected with this demand is that it cannot be supplied in a day, nor a week, but requires a good deal of study and labour and several months' time, so that in fact the preparation for the coming season is made when the preceding one is just commenced; the spring flowers are produced in the depth of winter, and the summer flowers blossom in fog and snow.

Some rollers have engine-turned patterns all over them, forming a ground; these are either cut by a rose-engine, or, which is much more easy in the case of large rollers, traced through varnish laid all over the surface of the roller with a diamond point, and then the lines thus marked bitten in with aquafortis, as in etching. Another mode is to trace the pattern by means of a diamond acted upon by galvanism: the pattern is traced on a zinc cylinder covered with varnish, which serves as a guide, a needle or point passes over the pattern, and being connected with the tracing-point, and in some cases with several diamond tracers, the design is reproduced with great precision and quickness. In consequence of these improvements and adaptations, very large rollers for furniture stuff patterns are now produced at a comparatively small cost.

The engraving of metal plates and rollers, wood blocks, or lithographic stones, is amongst the most important and interesting of all the arts, and there is scarcely a branch of manufacture to which it does not contribute, while it is the most valuable assistant of the fine arts. It has innumerable degrees of importance, from the cutting of a name on a pewter pot to the reproduction of the highest works of Art. In describing the methods of engraving we have no pretension of teaching the art, but only of drawing the special attention of our young readers to the subject. Self-taught engravers have been known, but there are many technical difficulties in the way which it is scarcely possible to overcome without instruction.

The art of engraving comprises three great divisions, for which appropriate technical terms have been found by referring to the Greek language, Copper-plate engraving is named *chalcography*, from the Greek words signifying *copper* and *to inscribe;* wood-engraving *xylography*, from *wood* and *to inscribe;* and engraving on stone *lithography*, from *a stone* and *to inscribe.*

The art of engraving was early known in England. Printing was discovered during the first half of the fifteenth century, and engraving quickly followed, as is proved by Caxton's "Golden Legend," printed in 1483, and ornamented with numerous cuts. Copper-plate engravings appeared in Vesalius's "Anatomy," printed in England, in Latin, in 1545. These were the work of Thomas Geminus, or Geminie, the first English engraver of whom we have a distinct account. A translation of the work by Udal, dedicated to Edward VI., contained in the preface the following passage: "Accepte, jentill reader, this Tractise of Anatomie, thankfully interpreting the labours of Thomas Gemini the workman. He that with his great charge, watch, and travayle, hath set out these figures in pourtrature, will most willingly be amended, or better perfected of his own workmanship if admonished." The first maps of English counties were engraved by Christopher Saxton in 1579.

In the reign of Charles I. an engraver-royal (Voerst, a native of Holland) was appointed, and the art received much encouragement from the king and the Earl of Arundel. The celebrated Vandyke assisted its progress by his vigorous and expressive etchings; various improvements were made; Prince Rupert discovered *mezzo-tinto*, and for a brief period engraving flourished greatly; but the bad taste and dissolute manners of the succeeding reign checked its progress, and had the worst effect on the art. Its subsequent revival and brilliant success in the hands of Hogarth and his cotemporaries, and its high eminence at the present day, present too extensive a field to be traversed here. Suffice it that we describe some of the processes of this interesting art as now practised.

Supposing a copper-plate engraving to be begun and carried on without the aid of etching, it is as follows:—A plate of copper is first prepared, smooth and free from all imperfections, very level, and highly polished. On this plate the outlines of the landscape or subject to be engraved must be accurately drawn. To this end the copper-plate is first heated in an oven till it attains a sufficient uniform heat to melt white wax, a piece of which is rubbed over it, and allowed to spread in a thin layer till the whole surface is equally covered, after which it is left in a horizontal position till the wax and plate are cold. In the interval a careful tracing of the original design is made with a black-lead pencil on thin tracing-paper, and this is afterwards spread over the waxed surface of the plate, with the lead lines in contact with it. The tracing being secured in this position, heavy pressure is applied, the effect of which is to transfer the lead lines from the paper to the wax. The engraver now takes a fine steel point, and (the tracing-paper being removed) goes over the subject lightly, so as just to penetrate the wax and touch the copper. By this means a perfect and

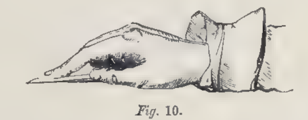


Fig. 10.

delicate outline is drawn upon the plate, and when the wax is melted off the subject is ready to be proceeded with and finished off, according to the skill and manual dexterity of the engraver. These are not within the powers of description; but we may briefly state that the principal instrument employed is the *graver* or *burin*, made of steel, and ending in an unequal-sided pyramidal point. This instrument is held in the hand at a

small inclination to the plane of the copper, and is pushed forward in the direction required to cut the lines on the plate (see Fig. 10). Should the lines be cut too deeply, a smooth tool about three inches long, called a *burnisher*, is employed to soften them down and to burnish out scratches in the copper. But the graver, in ploughing furrows in the surface of the copper, raises corresponding ridges or burrs; these have to be scraped off by another tool, about six inches long, called a *scraper*, also of steel, and having three sharp edges. A woollen rubber is also occasionally used, with a little olive oil, to clear the face of the plate, to show the progress of the work, and to polish off the burr. Engravers use a leather bag, filled with sand, as a cushion to support the plate during the progress of the work. Where a series of parallel lines are wanted, in architectural subjects or for skies, manual labour can be dispensed with and a ruling-machine substituted.

Besides engraving properly so called, there are several varieties known, as *etching*, *mezzo-tinto*, *aqua-tinta*, &c.

Etching now forms a most important part of the engraver's art, for nearly all his productions are commenced, and to a considerable extent carried forward, by its aid. It is the process of corroding with aqua-fortis the lines of a drawing, traced out with an etching-needle on the copper-plate, over which has been previously placed what is called an *etching ground*, namely, a preparation of bees'-wax, Burgundy pitch, &c., incorporated over the fire, and capable of resisting the action of the aquafortis. The following composition forms a good etching ground: two ounces of white wax, half an ounce of Burgundy pitch, half an ounce of black pitch, and two ounces of asphaltum. The ingredients, with the exception of the asphaltum, are put into a crucible and melted over a slow fire. The asphaltum meanwhile is reduced to a fine powder, and is stirred into the composition by degrees. When the substances are all intimately blended, the composition is poured into cold water and worked into balls about the size of a walnut, which are tightly and smoothly tied up in small pieces of plain worn silk. When the plate is to be prepared for etching it must first be heated with an equal heat throughout, by holding it by means of a hand-vice over a stove, or in an oven. A bit of folded paper will save the plate from injury at the points where the vice presses. No more heat is required than is sufficient to melt the composition, or etching ground, which is now applied by rubbing one of the silken balls over the plate, the warmth of which causes the substance to ooze through the silk. The ground is then equalised by rubbing with a dauber. This is variously contrived, but a simple kind is made of lamb's wool, properly washed and dried, and then tied up in soft fine muslin in the shape of a flattened ball. Outside this must be smoothly stretched and tied a piece of black silk, not new or twilled, otherwise it will cause the surface to be unequal. When the daubing is completed, and the etching ground smoothly and equally distributed, the copper-plate is held, face downwards, over the flame of a wax candle, or of two or three candles tied together, until the whole surface of the etching ground is smoked to blackness. It is then ready to receive the design, which is first made in outline with a black-lead pencil on a piece of thin even paper, and then placed face downwards on the smoked surface. The whole is then passed through the roller-press used for printing copper-plates, which transfers an impression of the outline to the ground. After this the design is completed with the etching-needles, a very fine point being used for the more distant and delicate parts, and a broader one for the nearer and bolder objects. These needles remove the wax composition or etching ground from the copper wherever they pass, and slightly scratch the surface of the plate, thus exposing it to the full action of the acid during the subsequent process of biting-in. To prepare for this, a border of wax half an inch high is put round the plate to form a trough for the acid. This is called *banking wax*, and is made of bees'-wax, common pitch, Burgundy pitch, and sweet oil, melted in a crucible and poured into cold water: when cold it is quite hard, but on immersion in warm water it becomes soft. The wax having been made to surround the copper-plate, and being sufficiently hardened, the next operation is to pour in nitrous acid, reduced with water to the proper strength (usually about one part acid to four parts water), which experience alone can teach. Its action on the copper is apparent in the rising of innumerable bubbles. When the acid has been on a sufficient time to corrode the fainter and more distant parts of the subject, it is to be poured off, the plate washed with water, and left to dry. These fainter parts are then to be varnished with a mixture of lamp-black and Venice turpentine, applied with a camel's-hair pencil, which stops the further action of the acid on those parts; hence the mixture is called *stopping ground*. When it is dry the acid is again poured on, and the action renewed on the bolder parts of the subject. This stopping-out and biting-in can be repeated as often as the nature of the subject or the taste of the engraver may suggest, so that many gradations of tint can be obtained. After this the waxen border is removed by heating the plate, and by a little further warming the etching ground can also be wiped off with a rag moistened with olive oil. The work is now complete, unless it be wished to finish it more highly with the graver. This is frequently done; for, as we have already noticed, almost every engraving at the present day is partly etched Etching points or needles resemble common needles, fixed in handles four or five inches long. Some are, however, made of an oval form, in order to produce broader lines. What is called the *dry point* is nothing more than the common etching-needle brought to a very fine point, for the purpose of cutting or scratching the more delicate lines of skies, &c. The dry point does not cut the copper clean out, but raises a slight ridge or burr, which is ordinarily removed with the scraper, but which may in some cases be left on with fine effect. This is the case with Rembrandt's etchings, in which the burr was left on till it wore away in printing. Early impressions of his etchings, in which this peculiarity is visible, are therefore much valued. Imitations of chalk and pencil drawings are sometimes produced by etching on soft ground; but this practice has been greatly superseded by that of lithography. Etching on steel is performed in the same way as on copper, the steel also yielding a greater number of good impressions. A species of etching is also employed in the representation of medals, a machine of peculiar construction being brought into operation. For etching on glass a ground of bees'-wax is laid on, and the design is traced with the needle as before. Sulphuric acid is then poured on, and fluor spar sprinkled upon it, or fluoric acid may be at once used: this is allowed to remain four or five hours, and is then removed with oil of turpentine. Etched imitations of chalk drawings of the human figure, called engravings in *stipple*, have a very soft effect, but are inferior to engraving. In this variety the whole subject is executed in dots without strokes on the etching ground, and these dots are bitten-in by aquafortis. Again, these dots may be harmonized with a little hammer, in which case the work is called *opus mallei*. In the method known as *mezzo-tinto* a dark ground is raised uniformly all over the surface of the plate by means of a toothed tool, and the design being traced, the light parts are scraped off from the plate by fitting instruments, according to the effect required. In *aqua-tinta* the outline is first sketched, and then a sort of wash laid on with aquafortis upon the plate, producing the effect of Indian-ink drawings. Copper-plate engraving, therefore, in all its varieties opens a wide field for the taste and industry of those who would perpetuate and multiply valuable works of art in the several styles best suited to their respective subjects.

Steel-engraving is performed in the same way as copper-plate engraving, with the exception of some slight modifications in the use of acids. Mr. Jacob Perkins may be said to have established steel-engraving by his invention of decarbonizing the plate, so as to make it fit to be engraved on, and also by his interesting method of multiplying impressions on steel-plates. Mr. Perkins's method of transfer-engraving originated in the transfer processes employed in engraving the copper cylinders used in calico-printing, as already described.

Wood-engraving (*xylography*) is said to have had its origin in China, the birth-place of many other valuable inventions, and to have been due to the peculiar structure of the Chinese language, in the writing of which a separate symbol is used for each idea, and words are not made up, as with us, by a combination of letters. The number of these symbols or characters is therefore so vast that it would be almost impossible to print their books with movable types. Their method of printing is therefore as follows: the work to be printed is carefully transcribed upon transparent paper, only one side of which is written on. The sheets are then glued down upon wooden tablets, and all the wood is cut away except that covered by the lines of the writing. From these raised wooden lines impressions are taken. This practice is of ancient date in China, and some of those who have bestowed research on the matter are inclined to fix it about A.D. 930. As far as it is now possible to trace the introduction of wood-engraving into Europe, it would appear that the Venetians, in their commerce with the Chinese, early learned this art, and practised it before it was known to other European nations. But the art was eagerly acquired by Germany and the Low Countries, and in 1433, or thereabouts, they carried on a considerable commerce in playing-cards and prints of saints. At that time the engraver on wood was called *formschneider*, or figure-cutter, a term still in use. The little prints of saints were rudely executed, and had a great sale among the common people. In Germany they were called *helgen*, or *helglein*; in France, *dominos*. They were at first sold separately, and thus were soon dispersed and lost; but after a time they were pasted into religious books for the sake of preserving them, and thus probably originated the custom of illustrating books with engravings. From that time the art made decided progress. Block-books, as they are called, made their appearance. These were books in which the productions of the wood-engraver were simply collected in the form of volumes, some of which are still extant. One of the earliest, called the *Biblia Pauperum*, or Bible of the Poor, consists of forty leaves, small folio, printed from the same number of engraved blocks of wood, on one side of the paper only. These prints are placed two by two, facing each other, so that by pasting their backs the book has the appearance of being printed in the usual way on both sides. The use of printed characters in books is closely connected with the origin of wood-engraving, but the exact time of the invention is a disputed point. One

of the most generally received accounts of this discovery is thus given by an old German chronicler :—

"At this time (about 1438), in the city of Mentz, on the Rhinè, in Germany, and not in Italy as some have erroneously written, that wonderful and then unheard-of art of printing and characterising books was invented and devised by John Gutenberger, citizen of Mentz, who, having expended most of his property in the invention of this art, on account of the difficulties which he experienced on all sides was about to abandon it altogether, when by the advice and through the means of John Fust, likewise a citizen of Mentz, he succeeded in bringing it to perfection. At first they formed or engraved the characters or letters in written order on blocks of wood, and in this manner they printed the vocabulary called a 'Catholicon.' But with these forms or blocks they could print nothing else, because the characters could not be transposed in these tablets, but were engraved thereon as we have said. To this invention succeeded a more subtle one, for they found out the means of cutting the forms of all the letters of the alphabet, which they called matrices, from which again they cast characters of copper or tin of sufficient hardness to resist the necessary pressure, which they had before engraved by hand."

In this latter process the original inventors were greatly aided by Peter Schoeffer, son-in-law to Fust, who shares with the other two in the honours accorded to the worthy citizens of Mentz. An early and celebrated result of the union of typography and wood-engraving was a Psalter printed on vellum by Fust and Schoeffer, at the end of which there is a congratulatory paragraph on the discovery of the art of printing. The large initial letters of this Psalter are beautifully executed and printed in two colours.

The artists of Italy competed successfully with those of Germany in the prosecution of this interesting art, but attention was recalled to German art by the engravings of Albert Dürer and his cotemporaries, during whose time wood-cutting was in high estimation. At the close of the sixteenth century this art had greatly declined in Germany, but was better understood in France and England than at any previous period. Yet it was reserved to the eighteenth century to give a powerful impulse to the art in Britain. This was done by Thomas Bewick, who showed, in his "British Birds," a most skilful and effective adaptation of the means his art then afforded of faithfully representing nature. He was undoubtedly the instrument of a great revival in wood-engraving, and led the way in that career of success which has since distinguished the wood-engravers of this country.

The processes connected with wood-engraving chiefly differ from those of copper and steel engraving with respect to the different nature of the material employed. Box-wood is the only kind that can be successfully employed for fine wood-engraving. It should be of a clear yellow colour, as equal as possible over the whole surface, without spots or variations of tint, which mark inequality of growth and consequently of hardness, and which are sometimes quite evident in the impressions taken from such blocks, the whiter portions being softer and more absorbent of ink, and retaining it more tenaciously. The natural hardness and toughness of box, with the poisonous nature of its juices, are of great importance in preserving blocks from the attacks of insects, to which apple, pear, and other woods, sometimes used for the purposes of engraving, are naturally liable. But box-wood requires to be well-seasoned, otherwise it is liable to warp and bend. If a block of unseasoned wood be allowed to lie flat for a week or two, it is almost sure to bend upwards at the edges. Blocks of wood, therefore, should always be placed on their side edges when laid by for future use, and in the process of engraving they should be turned over on their faces in the intervals of the work, or some degree of curvature may be given to them by the warmth of the engraver's hand. When a block becomes slightly concave, and the circumstance is not noticed by the pressman previous to taking an impression, the wood frequently splits. Blocks when smooth and polished are prepared for drawing on by simply rubbing the polished surface with bath brick in very fine powder, slightly mixed with water. When this thin coating is dry it is removed by rubbing the block with the palm of the hand: its only use is to make the surface less slippery. Some artists, previous to beginning their drawing, wash over the surface of the block with flake-white and gum-water, but if the white ground be too evident the effect is confusing to an engraver in the progress of his work. "The less that is done to alter the natural colour of the wood," say the best engravers, "the better." Flake-white is also apt to mix with the ink in taking a first proof, and to fill up the finer parts of the cut.

As box-wood is, notwithstanding its hard and compact nature, very much softer than copper and steel, and is, moreover, less equal in density throughout, so the graving tools must be guided in a different manner, and a check must be put on the force with which they are ordinarily sent forward by the palm of the hand. There are four descriptions of cutting-tools used in wood-engraving; and numerous specimens of each, differing in size and degrees of fineness, are kept at hand. Of the four kinds of tools, the first is the graver, differing little from that of the copper-plate engraver, but adapted to the purposes of wood-cutting by having the point ground to a peculiar form by rubbing on a Turkey stone. Eight or nine gravers of different sizes are generally required, commencing with a very fine one, called the outline tool. The upper part A, Fig. 11, is the back; the lower part D is technically called the belly; B is the face of the tool, C its point. The latter is so extremely fine that the line is scarcely perceptible when the cut is printed; the object being with this tool merely to form a termination or boundary to other series of lines. This tool, in common with others, is fixed in a convenient handle, which, as it is received from the turners, is perfectly circular at the end; but part of this rounded end is cut off after the blade is inserted, in order to accommodate the tool to the flat surface of the block, and also to insure its being ready to the hand in the right position for use when laid aside and then taken up again. Eight or nine gravers, Fig. 12, are required, beginning with the outline tool, and increasing in size and breadth. The engraver also adapts them to his particular purpose, either by making them finer, or by grinding them down to greater breadth, and rounding them slightly at the points. The lower dotted line in Fig. 12 shows the extent to which the points are usually ground down. Gravers are used for nearly every description of wood-cutting occasionally, not even excepting "tinting," the technical term applied to cutting series of parallel lines, which, when engraved, form an even and uniform tint. For this process, however, there is a distinct set of tools, Fig. 13, thinner, and ground to a much more acute angle at the face. These tools, though thin, ought to be sufficiently strong at the back to prevent their bending when used: their faces, as well as those of the gravers, should also be rather long than short, for they then cut with much greater clearness, and the shaving of wood turns gently over towards the hand, as shown in Fig. 14; whereas, when the graver is too obtuse, the shaving, instead of turning aside, coils over before the point of the tool, as in Fig. 15, and hides the pencil-line which the engraver is following.

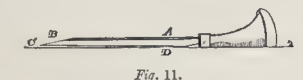
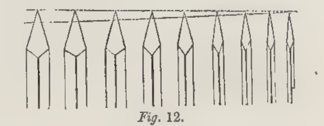


Fig. 11.


Fig. 12.

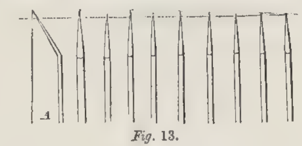


Fig. 13.


Fig. 14. *Fig.* 15.

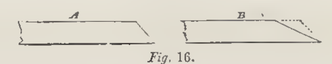
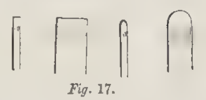
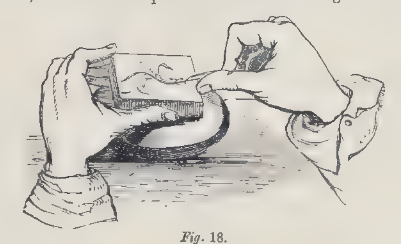


Fig. 16.


Fig. 17.


Fig. 18.

A, Fig. 16, is an example of an obtuse form of tool: this may be converted into an acute tool by grinding down the portion shown by the dotted lines in B. In addition to gravers and tint-tools there are gouges of different sizes, Fig. 17, for scooping out the wood towards the centre of the block, and flat tools, or chisels, for cutting it away towards the edges.

The method of holding the graver is different when the material is wood, to that employed in copper and steel engraving. In the latter case the forefinger is extended on the back of the tool, so as to press the point into the plate (see Fig. 10). In wood-cutting this is not necessary, but, on the contrary, the force of the hand has to be checked by the thumb, which in small subjects is rested against the side of the block, allowing the blade to move freely, but ever ready to check it in case of a slip (see Fig. 18). In larger subjects, the thumb accomplishes the same ends by resting on the surface of the block (see Fig. 19).



Fig. 19.

Engraving requires delicate and skilful workmanship, and makes large demands on the eyesight as well as on the dexterity of hand of those who practise it. Some parts of the work are generally supposed to require the use of magnifying-glasses, and much of it must necessarily be accomplished by lamp-light. The most experienced engravers, however, are slow to recommend the use of glasses to those who can possibly do without their assistance. Young persons commencing the art of wood-cutting seem to imagine that a magnifying-glass must of necessity form part of their apparatus. The sort of glass employed is similar to that of watch-makers, and consists of a single lens fitted into a short tube, and rather wider at the part applied to the eye. Such aid should only be sought when sight begins to fail; and even then the glass should at first be of low magnifying power. Various means are employed to protect the eyes from the light, and the face from the heat, of the lamp. One of these consists in the use of a large glass globe filled with water, which is interposed between the lamp and the engraver's block. By the use of these globes one lamp is found sufficient for several persons, and each person has a clear and cool light to work by. In damp or frosty weather the breath of the engraver is apt to injure his work, unless some contrivance be adopted to prevent its playing on the surface of the block. This is usually found in a screen of thin pasteboard or stiff paper, temporarily tied across the mouth and nostrils in such weather. The eyes have their own protection from a shade which most wood-engravers wear, not only to guard the sight, but also to concentrate the view on the work in hand. Such shades are, however, very objectionable, as they confine hot air close to the eyes, which require for healthy action the free circulation of fresh air.

The pupil in wood-engraving commences with the cutting of parallel lines or tints, straight and waved, and then proceeds to simple forms in outline, without any shading that is expressed by cross-lines; such shading is necessarily difficult in a material where all the parts intended to be light have to be cut away, and the dark lines alone remain standing; and consequently in cross-shading the interstices have to be carefully cut out without injury to the lines. Complicated subjects should be long deferred, and never attempted till decided success has attended the simpler efforts.

Lithography, or engraving on stone, is a modern invention, ascribed to a musician named Senefelder, connected with the theatre at Munich, about the year 1800. The term engraving is not truly applicable to the process, as usually carried on; but in Germany a great deal of actual engraving on stone with the burin is practised. The results of this method, however, are so greatly inferior to those of copper-plate engraving, that it is not likely ever to come into general use. The art of taking impressions from drawings made on stone depends on the readiness with which calcareous stone imbibes water, its great disposition to adhere to resinous or oily substances, and the disposition those substances have to combine, and to repel water or any substance moistened with water. Drawings made on a polished surface of calcareous stone with a resinous or oily substance adhere strongly to the stone, and are not at all affected by water poured over it, and which the other parts imbibe readily. But if a resinous or oily body be then passed over the stone, it will adhere strongly to the drawing, and not to the watery parts of the stone.

The drawings, therefore, in lithography are made with ink and chalk of a soapy nature. The ingredients of the former are tallow-soap, pure white wax, lamp-black, and a small quantity of tallow, all boiled together, and when cool dissolved in distilled water. The ingredients for the chalk are the same, with a small quantity of potash added during the boiling. After the drawing on the stone is perfectly dry, a very weak solution of sulphuric acid is poured over it, which takes up the alkali from the ink or chalk, and leaves an insoluble substance behind it, while it lowers in a slight degree the surface of the stone not drawn upon, and prepares it for the free absorption of water. Weak gum-water is next applied, to close the pores of the stone, and keep it moist. The stone is then washed with water, and the printing-ink applied in the ordinary way. It then passes through the press; the washing with water and daubing with ink being repeated after every impression. The impressions may be multiplied to a great extent without any marked failure in the effect. As many as 70,000 copies or prints have been taken from one stone, the last being nearly as good as the first. The work can also be performed with great expedition and economy. Drawings made with the chemical ink on paper prepared with a solution of size or gum tragacanth can be transferred to the stone by being merely laid thereon and passed through the press, when the subsequent processes can be carried on as already described. Copper-plate and steel engravings can be transferred to stone and worked by power presses, thus lessening the expense of working.

It has long been a reproach to our country that scarcely anything has been done towards raising the character of our manufactures by the systematic training of workmen; in manufacture as in art all was left to private enterprise or private negligence. We were awakened to the fact at last that in design we were behind our neighbours, and as they had progressed immensely of late years in manufacture, we might possibly lose much of our foreign trade: the consequence was, that immediately after the Great Exhibition the School of Design, which had been formed some years previously, was completely remodelled and made part of the establishment of South Kensington. The teaching of science as well as art was included in the plan, but nothing much was done until lately in that direction. We believe this branch is now well organized, and it is to be hoped that it will be of as much benefit in popularising science as in awakening artistic taste and forcing artistic ability. Still the Science and Art Department does not include all that technical education to which foreign workmen owe much. At Lyons, Mulhausen, and other centres of textile manufacture, in France, Germany, and other countries, there are weaving and other schools, where apprentices and workmen are taught both the theory and practice of the trade to which they have devoted themselves: these young men become expert workmen, are well prepared for the duties of foremen, and eventually masters, and the level of the whole trade is raised by their superior intelligence.

At last the necessity for action has been recognised; the Government has a scheme under consideration for the formation of a practical museum. Manchester has now its Owens College, which is intended to give thorough theoretical and practical training to youth intended for manufacturing trades, and Leeds has a college which includes weaving and other schools. This last-named institution has received £60,000 in donations. The Clothworkers' Company of London supplied the means wholly, or in part, for the foundation of a weaving school, and has since presented the institution with the handsome sum of £10,000 for building purposes.

The weaving school of the Yorkshire College of Science is under the charge of a gentleman evidently most earnest in the cause, Professor Beaumont, and he with another gentleman visited not long since the technical schools of the Continent, and reported fully upon them.

A proposition has been made for a textile manufacturers' association, to give consistency and power in the promotion of technical education in the cotton, woollen, silk, and linen districts; and the foundation of technical schools with a central college has been laid by a committee appointed by the principal livery companies of the city of London.

It should be known that most of the centres of the textile trades in France, Germany, and Belgium have their special organs, generally well-conducted, as well as their technical institutions, with their chemical, mechanical, and other committees: the effect of such organization cannot be doubtful.

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PARIS CARVED OAK.

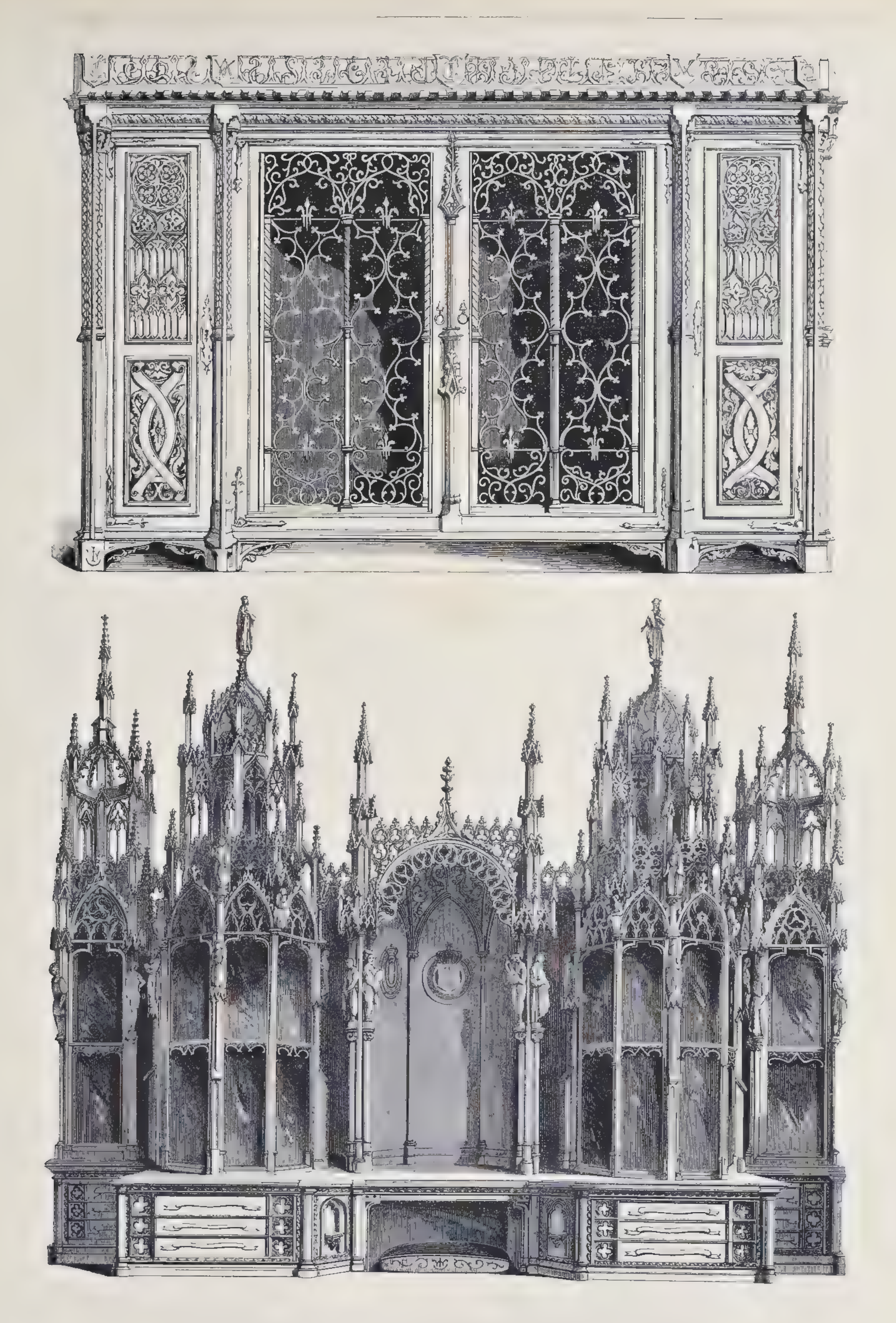
ONE of the most magnificent examples of decorative woodwork contributed to the Great Exhibition of 1851. It is the production of M. Fourdinois, of Paris, of whose beautiful work many examples will be found in these pages, and who, besides producing cabinet work and carving of the highest excellence, has trained in his other *ateliers* artists worthy to follow in his footsteps. We could not place before our readers a finer example of modern French work in the Renaissance style; the general form is designed with the skill of an educated and experienced architect, and the details are as appropriate as they are full of animation. Where all is admirable, we need only call attention to the four chief figures, which represent the four quarters of the globe, to that of Plenty crowning the edifice, and to the two charming groups on her right and left representing Corn and Wine. The effect of the whole is heightened by the brilliant colours of the painting which occupies the great central panel; but the grand charm of this beautiful work consists in the exquisite harmony of the whole.



ENGLISH PAPIER-MÂCHÉ.

OF the five good examples of papier-mâché represented above, the smaller of the two Cabinets is by Mr. Lane, of London; the elegant Toilet-table and Glass and the two Chairs by Messrs. Jennings and Bettridge; and the Cabinet on the lower line by Messrs. McCallum and Hodson.

Papier-mâché furniture is a thing of the past, but nothing is so well adapted for small articles as this material; and the tea-trays, small occasional trays, and other useful and elegant things now produced in Birmingham in paper, as well as in wood and iron, in rivalry of the beautiful ware of Japan, are well deserving of attention.



ENGLISH AND AUSTRIAN GOTHIC WORK.

TWO of the most admirable examples of modern Mediæval work which the Great Exhibition of 1851 produced, so utterly dissimilar one to the other that each brings out the beauties of the other by contrast. Such works require no comment; they simply offer the opportunity for study. They are by two of the first houses in Europe; the upper work a Cabinet in oak and brass work, by Messrs. Crace, of London; the other a Bookcase, also in oak, by Herren Leistler, of Vienna, designed as a present from the Emperor of Austria to the Queen of England: a truly imperial present.

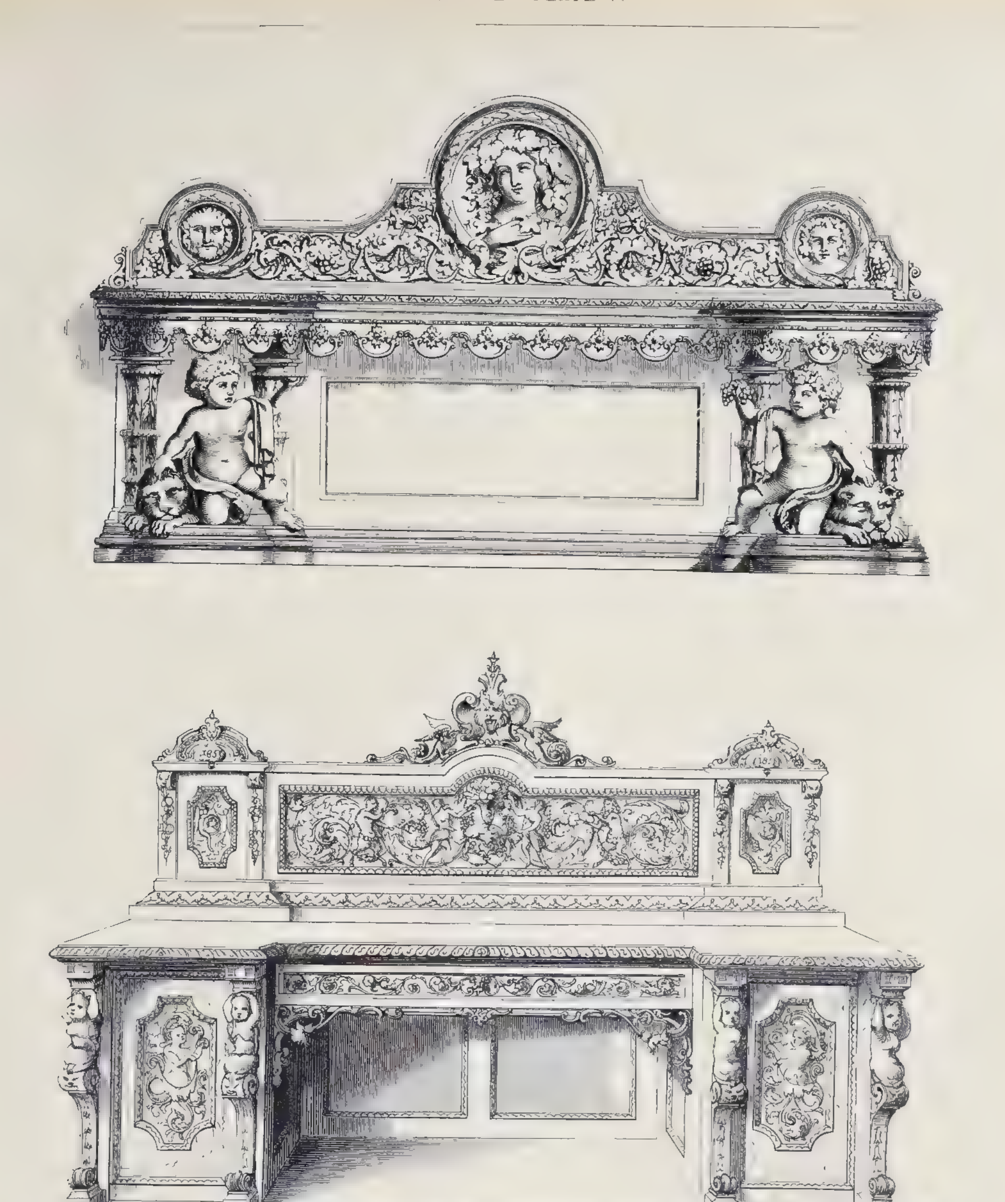




LONDON ORNAMENTAL WORK.

TWO Bedsteads shown in 1851, which are highly creditable to the cabinet-makers and upholsterers of London. The larger of the two is by Mr. T. Fox; it is a state bed in the Elizabethan style, but judiciously treated in a lighter manner than is common. The lower portion represents that style faithfully; the head, according to our view, is an improvement upon it, and is remarkably graceful. The mask in the centre of the foot-board is that of a Bacchanal. The bedstead is formed of walnut-tree wood, and gold is used here and there to relieve the somewhat sombre colour of that wood; the grain of which, however, is beautiful. The hangings are of rich light blue silk, with satin margins and white trimmings, and the head-board is stuffed.

The other Bedstead is the work of Messrs. Smee and Son, also of London. It does not exhibit any elaborate ornamentation, but it is very elegant and highly finished; it is in mahogany, boldly carved, and the hangings are of rich Spitalfields crimson silk.



ENGLISH CARVED SIDEBOARDS.

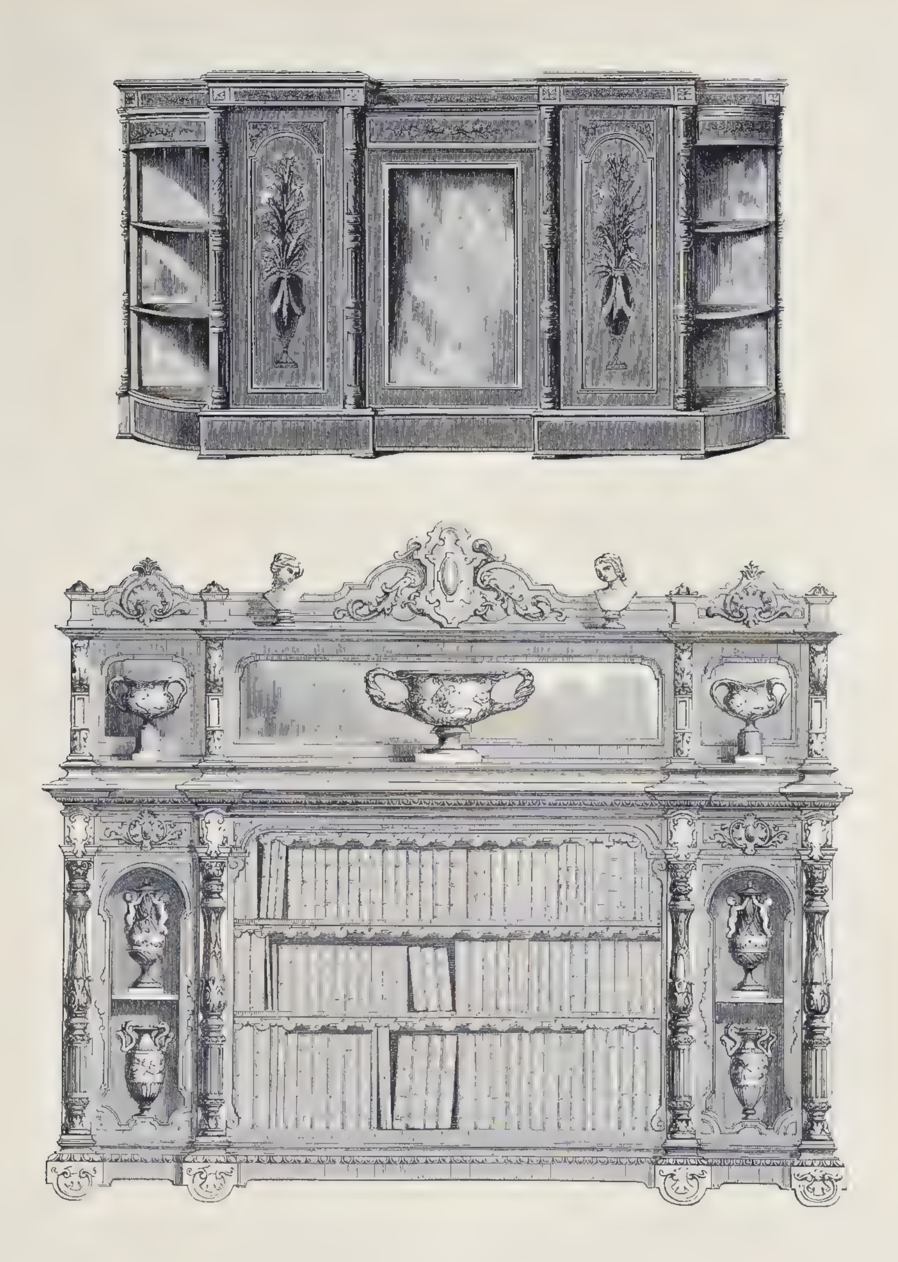
THE upper figure represents a magnificent carved mahogany sideboard, exhibited by Messrs. Johnstone and Jeanes, of London, so long ago as 1851. It is a remarkable piece of workmanship, conceived in the purest Italian style, and carved with a masterly hand; it is elaborate, as the style demands, but it is bold and not overlaid with ornament. The theme of the design is entirely Bacchanalian; the fine face which occupies the central medallion is that of a Bacchante, and the smaller faces those of Bacchanals, and a young Bacchus with a lion occupies each side below, one holding a bunch of grapes and the other a wine-cup. The scroll-work consists of vine leaves and grapes treated according to the conventional style of the period.

The second figure is a Sideboard formed of New Zealand woods, the decoration by the late Signor Lavati; exhibited by Mr. Levien, of London, in 1851.



VIENNESE CARVED WORK.

ONE of the chief articles, if not the most important, of the magnificent collection of artistic furniture shown in the Austrian department of the Great Exhibition of 1851 by Herr Carl Leistler, several other examples of whose skill and taste appear in these pages. It is a grand State Bed, executed in the beautiful wood of the locust-tree, our common pseudo-acacia, and is decorated with a series of statuettes and bas-reliefs in the same material, typical of the early history of the human race, the series commencing with figures of Adam and Eve on the foot-board and terminating with scenes of the regeneration at the head; the posts are elaborately designed, and carved ornamentation is profusely lavished upon the work, which is all executed not only in a truly artistic spirit, but with very great skill. In thorough accordance with such a sumptuous structure, the hangings are of crimson damask and velvet of several tints, and fringed with gold lace—truly a resting-place for an emperor.



LONDON DECORATIVE WORK.

THE first object represented on this page is a very elegant Cabinet with rounded *étagère* ends, contributed by Mr. Levien, of London, to the Exhibition of 1862. Apart from the gracefulness of the design of this cabinet, it has an interest from the fact that the inlaid work is executed with various beautiful New Zealand woods, which at the period named were comparatively little known, and which Mr. Levien was mainly instrumental in introducing to English Art-manufacturers.

The lower and larger figure is an engraving of one of the many admirable works exhibited by Messrs. Jackson and Graham in 1851; it is a combination of the bookcase and *étagère*, a beautiful piece of furniture for a drawing-room or boudoir. Like all the productions of this firm, the general design is excellent, and the details in perfect keeping; choice examples of the potter's art *set*, as it were, in such a beautiful frame, exhibit themselves to surprising advantage, and appeal to the admiration of every artistic eye. An admirable mode of bringing out all the value of a collection of works of Art is to place the best examples, a few at a time, on such an *étagère* or on a *dressoir*.

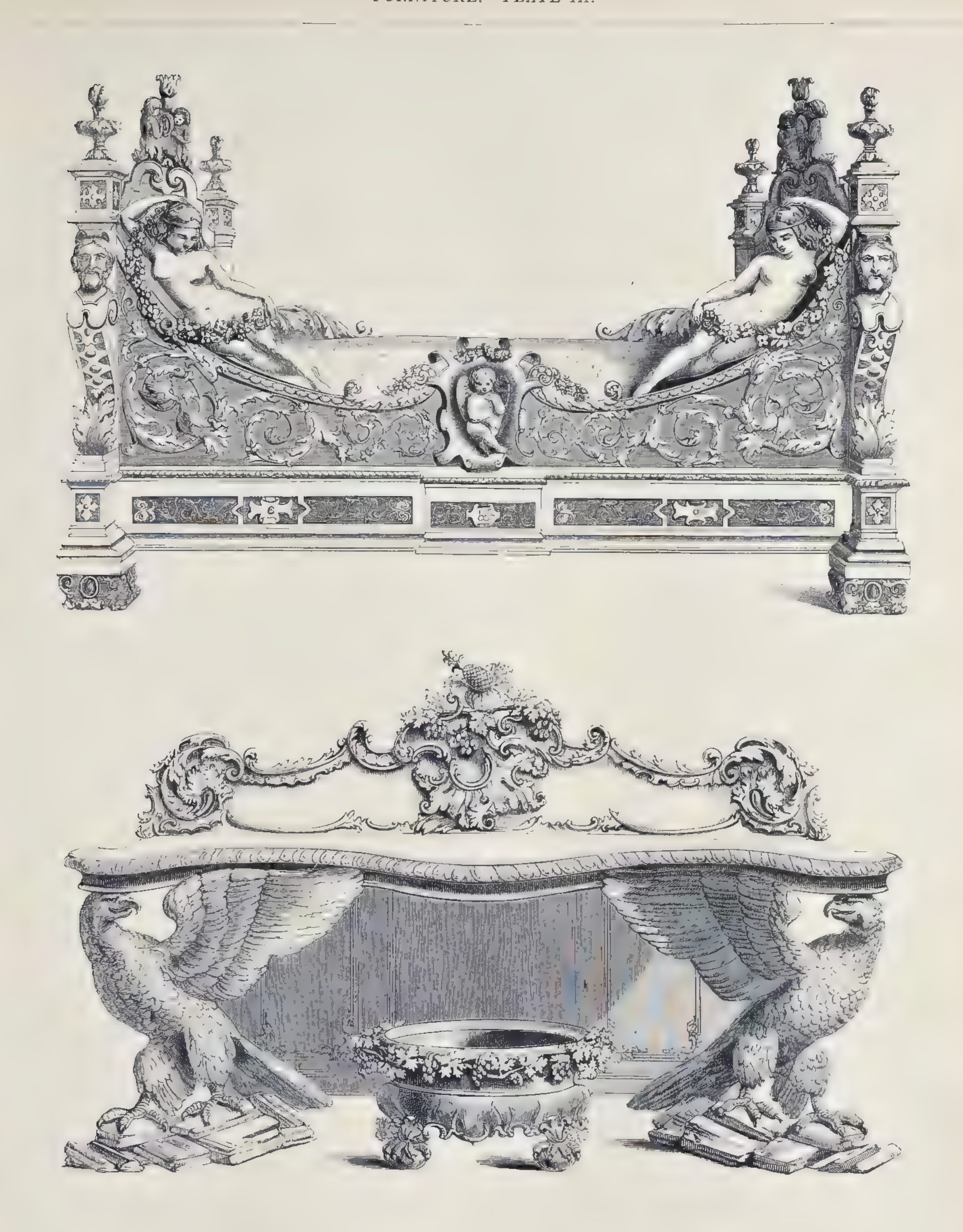


VIENNESE FAUTEUILS.

EXAMPLES of the work of two of the most eminent cabinet-makers in the capital of Austria, and all presenting remarkable features. That towards the right hand above is by Herr August Kitschelt: the design is unusually fanciful, and the details are in keeping, the chair being covered with velvet of various hues, delicate pink and blue predominating, and trimmed with fringe of a pale golden hue, most cleverly harmonized.

The other examples are by Herr Carl Leistler. The two Fauteuils towards the left hand form portions of the furniture for a suite of palatial rooms. They are both made of the wood of the locust-tree, and the carving and upholstery are of the highest character; altogether, remarkably good work. The Grand Fauteuil is another specimen of the very highest work of its class, constructed with every consideration for the comfort of the sitter. The artistic decorations are designed and executed in masterly style—a truly imperial resting-place.

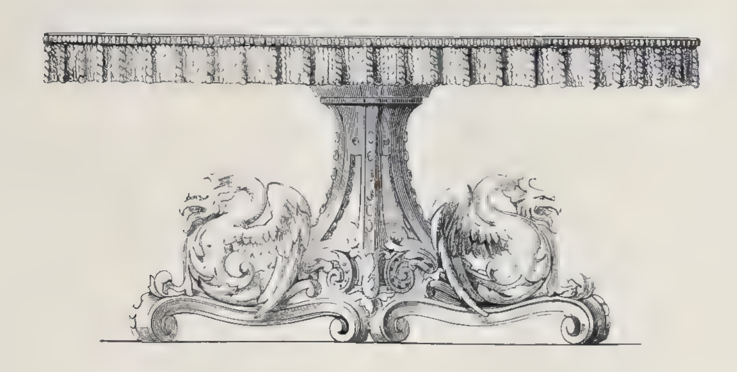
It should be mentioned that all these excellent works date back to 1851.



BELGIAN AND ENGLISH CARVED WORK

THE upper figure is that of a most magnificent ebony Bedstead by a celebrated carver, M. Boulé, of Antwerp, who was engaged by the Belgian Government to repair the famous carvings in the cathedral of that city. The example before us is a magnificent specimen in the florid Italian style, and the drawing and modelling are of the highest class. As a *chef-d'œuvre*, it is in every way admirable, but far too beautiful ever to be used; we should prefer to sleep opposite to it, not in it. This beautiful specimen of carved ebony work formed a prominent feature at the Exhibition of 1851.

In contrast with the florid Italian beauty of M. Boulé, we had at the same Exhibition the accompanying example of the thoroughly unconventional, by the well-known house of Gillow, of London. So tiresome is the constant repetition of the same scrolls, the same cartouches, the same griffins, flying dragons, and other still more unnatural-looking beasts, that we must admit that an example of the unconventional is refreshing now and then. Still, a new style cannot be evolved in a day, nor a year, nor perhaps in a dozen years, and the example before us can only be regarded as a praiseworthy attempt, and an admirable specimen of wood-carving.





ENGLISH CARVED TABLES.

THE first figure represents a decorated Table for a drawing-room by Mr. C. H. Whittaker, of London. The flying dragons, or whatever the mythical animals in the old Italian manner may be called, are admirably designed and well posed.

The table represented below is the work of Mr. Palmer, an eminent upholsterer of Bath. The carved work is remarkable for boldness in design and execution, and work of its class was not common in 1851, when it was exhibited.



PARISIAN CABINET.

A WORK in ebony and bronze, exhibited by M. Durand in 1855. It is remarkable in more than one respect. In the first place, the combination of bronze with ebony is scarcely known in this country; in the second, the body of the work exhibits charming simplicity and purity of style; and thirdly, the ornamentation is of the best kind. The introduction of the semi-detached "laterals," again, is one of those pretty novelties which strike every eye, the way in which they are supported being charmingly original and yet in perfect keeping. The effect of this delightful work (which, it should be mentioned, is not a mere ornament, but a piece of useful boudoir furniture about 5 feet in height) is immensely enhanced by the presence of the great central and two narrow lateral panels exquisitely painted on Sèvres porcelain, and by slabs of choice lapis-lazuli and other beautiful stones in the panels above and below the central *plaques*.



ENGLISH AND FRENCH CARVED WORK.

THE figure at the head of this sheet represents a Billiard Table by Messrs. Thurston & Co., of London, in which the decorative carving is remarkably bold, and admirably suited to such a piece of furniture.

The other Billiard Table is by the same firm, and presents a curious contrast to the preceding. Here we have a costly and most elaborate work intended for some noble Gothic residence, and executed most appropriately in English oak. The subjects which fill the panels in the sides and ends of the table—properly executed in low relief, so as to offer no impediment to players and to be out of danger of accident—are fifteen in number, and illustrate the famous struggle between the houses of York and Lancaster, the "Wars of the Red and White Roses." These bas-reliefs, and doubtless the rest of this capital work, were designed by Mr. J. W. Allen.

The remaining figure to be noticed is that of an Ebony Table, richly decorated with ormolu, exhibited by Messrs. Roux, eminent Parisian *ébénistes*. The daring eccentricity exhibited both in the form and ornamentation of this work are very striking and peculiarly French; the execution of all the details is equally characteristic and admirable.



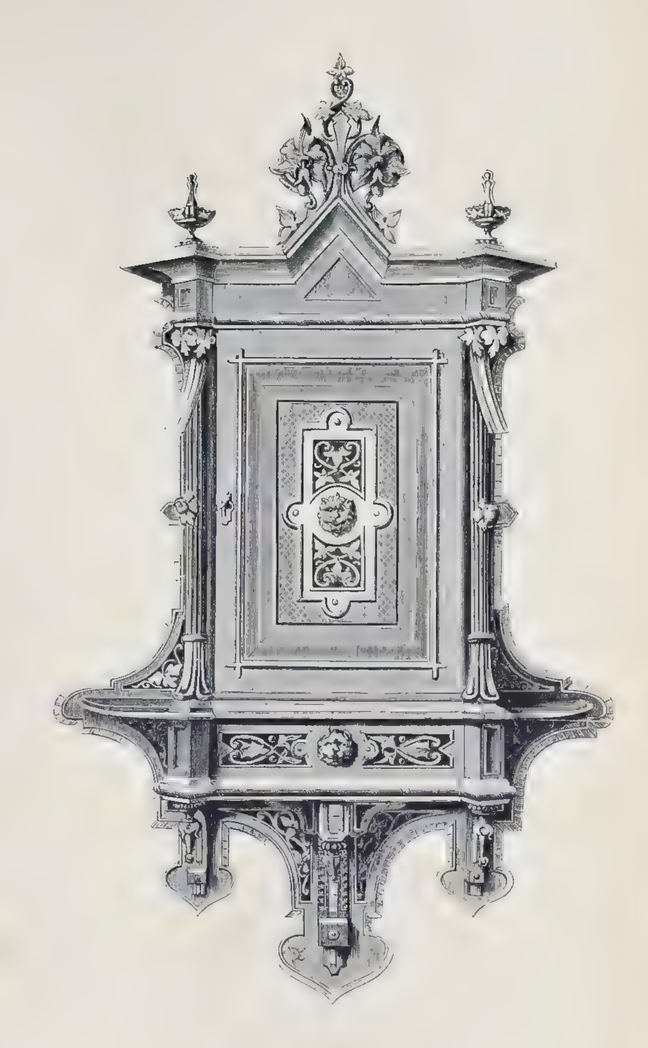


ENGLISH DECORATED CHAIRS.

TWO remarkable works by English designers and manufacturers, setting each other off by the striking contrast between imperial pomp and rustic fancy. The Chair to the left hand of the reader was produced by Mr. G. Shacklock, of Bolsover, in Derbyshire, and shown in 1851; it is called the *Heraldic Chair*, its decorations consisting of the arms borne by the ancestors of Her Most Gracious Majesty, in the Saxon line.

Its rustic companion is by Mr. Collinson, of Doncaster, and reflects great credit on his taste and skill, if design and workmanship are all his own. The Chair was made for Mr. Chadwick, of Arksey, near Doncaster, of oak supposed to be two thousand years old, two trees measuring together two hundred feet (timber measure) having been found below the bed of the river Dun at Arksey about the year 1848. Mr. Collinson has had the good taste to decorate his handsome chair with its own leaves and acorns, without any other addition but the crest of the proprietor.





LONDON AND VIENNA WORK.

THE Cabinet towards the left hand formed one of Messrs. Holland and Sons' admirable contributions to the Paris Exhibition of 1855. It is of polished ebony, with brass mouldings and ornaments and painted china panels. The painting on the chief panel is a copy of "The Ford," by Mulready, now in the Vernon Gallery at the South Kensington Museum. The eight panels which form a border to the preceding are decorated with representations of fruit, flowers, musical instruments, and other elegant objects, and the oval panel below has a landscape painted on it. Six small cameos relieve the upper part of the cabinet, which rests on the table, with brass tortoises as supports. The design is the work of an eminent architect of Dresden, Herr Semper.

The Gothic Cabinet of Herren Theyer, of Vienna, is a beautiful piece of Art-workmanship, exhibiting rare excellence of design and perfection of execution both as regards general form and detail—a treat to dwell upon; so much so, that we scarcely like to point out what we conceive an unfortunate eccentricity, namely, the pieces which appear jutting out from beneath the capitals of the two side columns, otherwise so perfectly graceful.



ANTIQUE GERMAN FURNITURE.—Sheet I.

THE objects represented on this and the three following sheets were selected as illustrations by Professor Heideloff, author of "Die Ornamentik des Mittelalters," from various royal and patrician mansions and other places in Germany, and form a highly interesting collection of Mediæval furniture, remarkable for quaint characteristic beauty. The Chest (No. 1) is from the original at Stockach, bearing date 1470. The two oaken Tables (Nos. 3 and 21) are, the first from the Rhenish town of Oberkirchen, the second from the Castle of Strasbourg. An Arm-chair (No. 4), from the ancient Castle of Steinberg—formerly in the possession of the Von Wenningen family and demolished in 1803—is characterized by good taste; as also is the Stand for a basin (No. 20), to be used in the library or bedchamber. The Chair No. 5 is from the Castle of Würtemberg; the Chair No. 6 was made for the use of the Burgomaster in the old town of Erfurt, in


No. 11. No. 12. No. 13. No. 14. No. 15. No. 16. No. 17. No. 18.

ANTIQUE GERMAN FURNITURE.—Sheet II.

the fifteenth century, and its details are very beautiful. The oak Chair (No. 7), also a work of the fifteenth century, was found in a garret of the Castle of Hohentuebingen in Würtemburg. The Chair (No. 10) was designed by Professor Heideloff, in accordance with antique models; as was also the Table (No. 18), and they may both be accepted as faithful reproductions in the picturesque style of about the fifteenth century. The Table (No. 11) is copied from one in the drawing-room of the lofty fortress of Lichtenstein, on the Rauhe Alle (Würtemberg), an ancient residence which belongs to the Count Wilhelm, of Würtemberg, and which was restored, under the direction of Professor Heideloff, from the designs of the architect Eberlin. The very singular Table (No. 12) supported by kneeling figures is also a work of the fifteenth century: it is carved in oak, and once belonged to the Castle of Sleusslingen. The beautiful oaken Table (No. 14), with its tasteful enrichments and inlaid ornament, was some time ago in the possession of an antiquary in the town of Lauingen, Bavaria. The Footstools (15 and 16) are from the Castle of Hohenrechberg, a patrician house in


No. 19.
No. 20.
No. 21.
No. 22.
No. 23.
No. 24.
No. 25.

ANTIQUE GERMAN FURNITURE.—Sheet III.

Nuremberg—both of the fifteenth century. The Cradle (No. 19) is from a remote village in the Rauhe Alps. The figure No. 22 represents another Washhand Stand, similar to that previously mentioned. The curious Cupboard (No. 23) is in the Castle of Hoentuebingen; it is of the time of Duke Eberhard the First. The beautiful Escritoire (No. 24) belonged to the hunting-seat of Stettin. The Wardrobe (No. 25), made by Boeblinger, was formerly preserved in the Vestry of the Chapel of the Hospital at Esslingen, in Würtemberg. The Reading-desk (No. 26), with canopied chair attached, is that of a Professor of the University of Freiburg, and was made in 1456. The very beautiful Clock (No. 27) is from a design of the fifteenth century. The Bedstead (No. 28) was discovered by the Professor in a loft of the ancient Castle of Urach, in Würtemberg, in the year 1810; it was in pieces, and was restored by the Professor: Castle Urach was built in 1444 by Count Ludwig, and in 1474 the marriage of Count Eberhard with Barbara, Princess of Milan, was celebrated in it, and it is, therefore, not unlikely that we have before us their bridal couch. The Escritoire (No. 29)



BERLIN AND AMERICAN CHAIRS.

A COLLECTION presenting great variety. The very pretty Wooden Chair at the head and that above on the left-hand side are the work of Messrs. Louis and Siegfried Lövinson, of Berlin, and Jacoby, of London, famous for their carved work, several of whose productions will be found in our pages.

The large figure in the middle of the sheet and that which lies to the right of it are examples of the American Revolving Spring Chairs, which met with signal success at the Great Exhibition. They are mounted on a pivot and revolve like a music-stool, while four curved springs of great strength allow of easy motion in every direction. The Americans have surpassed every nation in the comfort of their chairs, and in these cases the designs are elegant and the execution admirable. These are the work of the American Chair Company, of New York. The Wicker Garden Chair is also American, the work of Mr. Tope, who has exhibited much taste and ingenuity in the design and execution.

The middle figure below represents one of Mr. Sedley's Easy Chairs, the inclination of which can easily be altered to please the sitter: this chair is also of excellent design. The chair which fills the remaining space is a good example of papier-mâché work by Messrs. Jennens and Bettridge, of London and Birmingham.



ENGLISH, IRISH, AND ITALIAN GILT FANCY WORK.

THERE are few articles of domestic furniture which had fallen so low, a few years since, as looking-glass frames: here and there, in a well-arranged house, the eye welcomed a looking-glass frame in keeping with the architecture of the house; but, generally, the ornaments of looking-glasses and of picture-frames, when decorated at all, were lamentable from every point of view, tasteless and fragile. So bad had the art, if we may so call it, become that good taste at last revolted, and almost confined itself to simple mouldings. The elegant piece of carved work, for the top of a glass, which crowns this sheet, does great credit to Messrs. R. Strahan & Co., of Dublin.

The two Tables are by Messrs. Morant, of London, and were exhibited in 1851; the smaller of the two, supported by storks, has a plate-glass top, painted in imitation of Florentine mosaic work; the other table is from a design of the late Duchess of Sutherland, to whose taste and liberality the decorative arts owe much, and for whom the table was made.

The remaining figure represents a Pier Table admirably designed and carved by the Brothers Panciera Besarel, of Venice. This and other like productions by the same clever artists attracted attention at the Paris Exhibition of 1867.



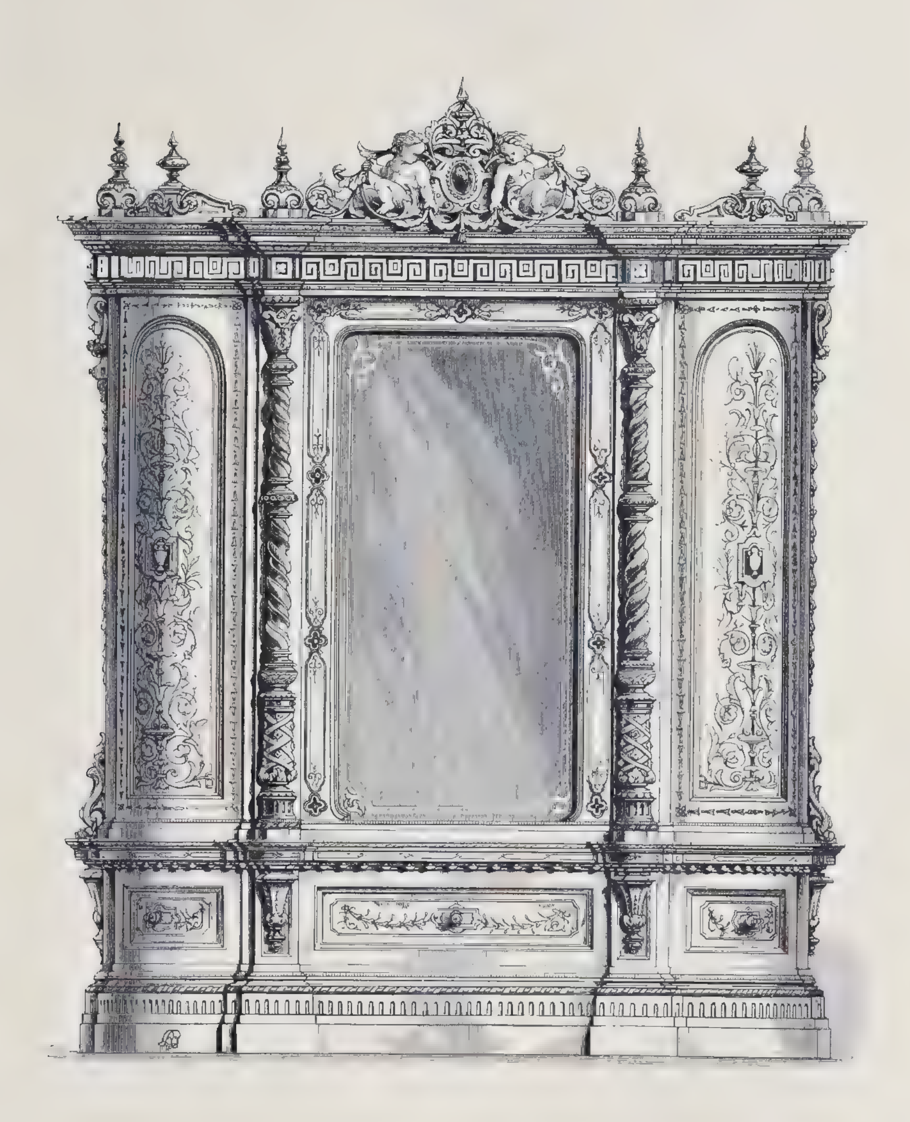
ENGLISH AND FRENCH DECORATIVE OBJECTS.

THE elegant Screen to the right on the upper line is one of the productions of Mr. Levien, of London.

The Chair which occupies the opposite corner is a good specimen of a simple kind of Flemish make of the sixteenth century.

Towards the left hand, below, is the figure of a remarkably elegant Screen by Messrs. Morant, Boyd & Co., of London, who, as on former occasions, contributed some of the best examples of fine cabinet work, this screen included, to the Vienna Exhibition.

The handsome Coffer or Jewel Case which completes the group is the work of M. Reister, of Paris, who has supplied us with several excellent illustrations: it is a very choice work, composed of ebony with steel panels, the larger of which are engraved and inlaid with gold; the smaller panels are of silver chased, producing a beautiful contrast with the black wood; the feet are also in chased silver, and the spirited group on the top is carved in pear-tree wood. This exquisite work was shown in Paris in 1855.



LONDON CABINET.

THE Parisian *ébénistes* surprised most visitors to the Great Exhibition of 1851, and in Paris in 1855 they showed still more taste and skill; but in presence of the many beautiful works of our neighbours, the productions of our best cabinet-makers were unsurpassed, and one of these was the beautiful Cabinet here represented, designed by a student in the School of Art, and executed entirely by English workmen under Messrs. Trollope. The general effect is extremely pleasing to the eye, and the details are remarkably graceful. The Cabinet is composed of the choicest woods and inlaid, and the whole work is executed in the most finished manner.



BRITISH PAPIER-MÂCHÉ.

THE Cabinet, the elegant Alhambra Screen, which occupy the lower line, and the Vase above the latter, are the work of Messrs. Jennens and Bettridge; the small Work-Table in the middle above is by Mr. Jarnier; the oval Casket which occupies the upper corner towards the left hand, exhibited by Mr. Austin, is also the manufacture of Messrs. Jennens and Bettridge; the Inkstand and Tea-Caddy, beneath the Casket, are by Mr. Clay.



FRENCH, ENGLISH, AND CANADIAN CHAIRS.

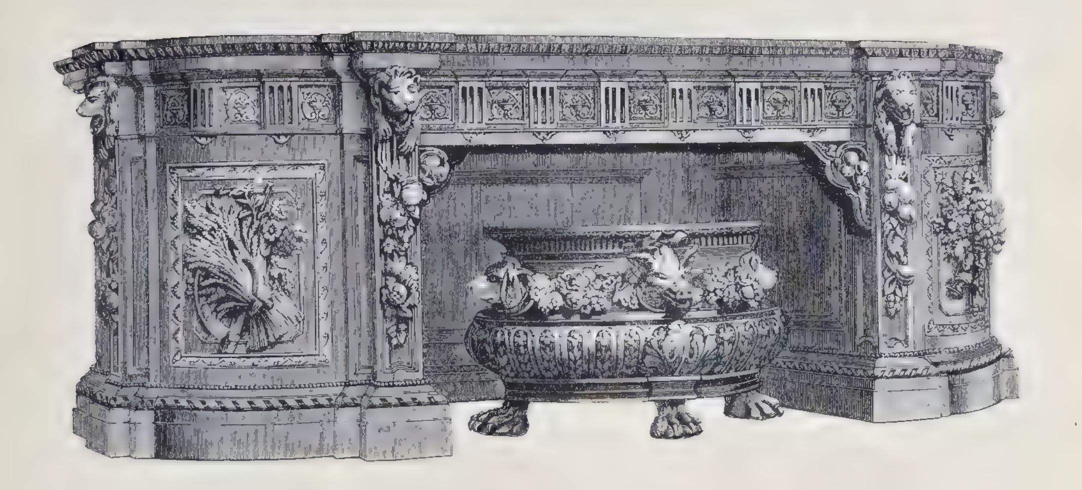
THE handsome old-fashioned Arm-chair which fills the central place above is interesting for several reasons: it was manufactured by Messrs. Hilton, of Montreal, in Canada; the embroidery was executed by ladies of the same place; it was shown at the Great Exhibition and presented to H.M. the Queen, for which purpose it was specially designed and executed.

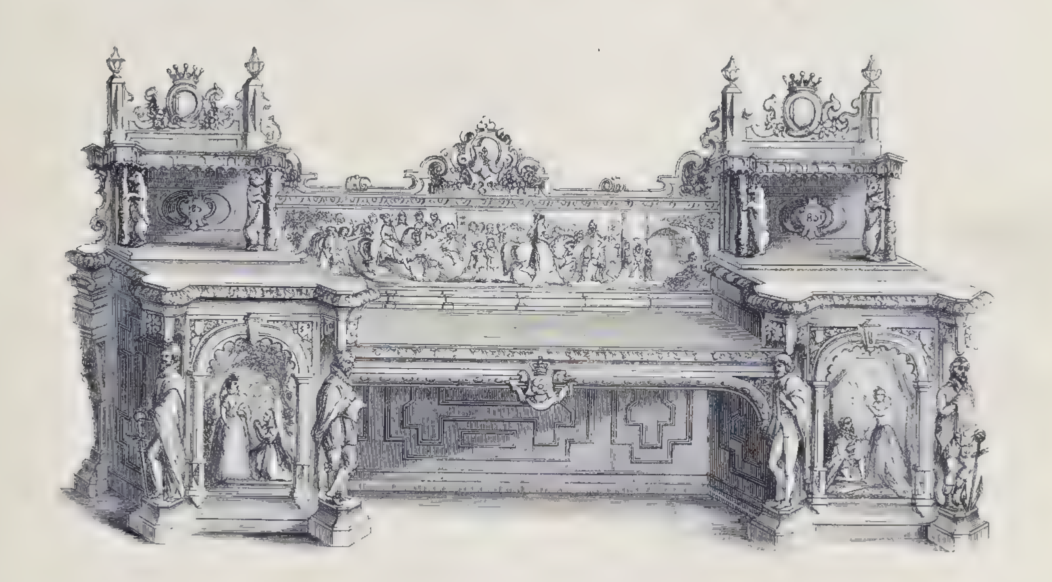
The Chair to the left hand above is peculiar: it is in the Elizabethan style, well carried out by an eminent *ébéniste* of Paris, M. Balny, who has contributed some remarkable furniture to our exhibitions.

That which occupies the corresponding position on the other side presents a good original design; it is executed in mahogany with the grain running always in the same direction; it is the work of Mr. G. W. England, of Leeds.

Below on the left hand is a very elegant drawing-room Chair, beautifully carved and admirably shaped for comfort, by Messrs. Hunter, of London.

The remaining two Chairs are admirable specimens of the best English design, and manufactured by Messrs. Jackson and Graham, of London.

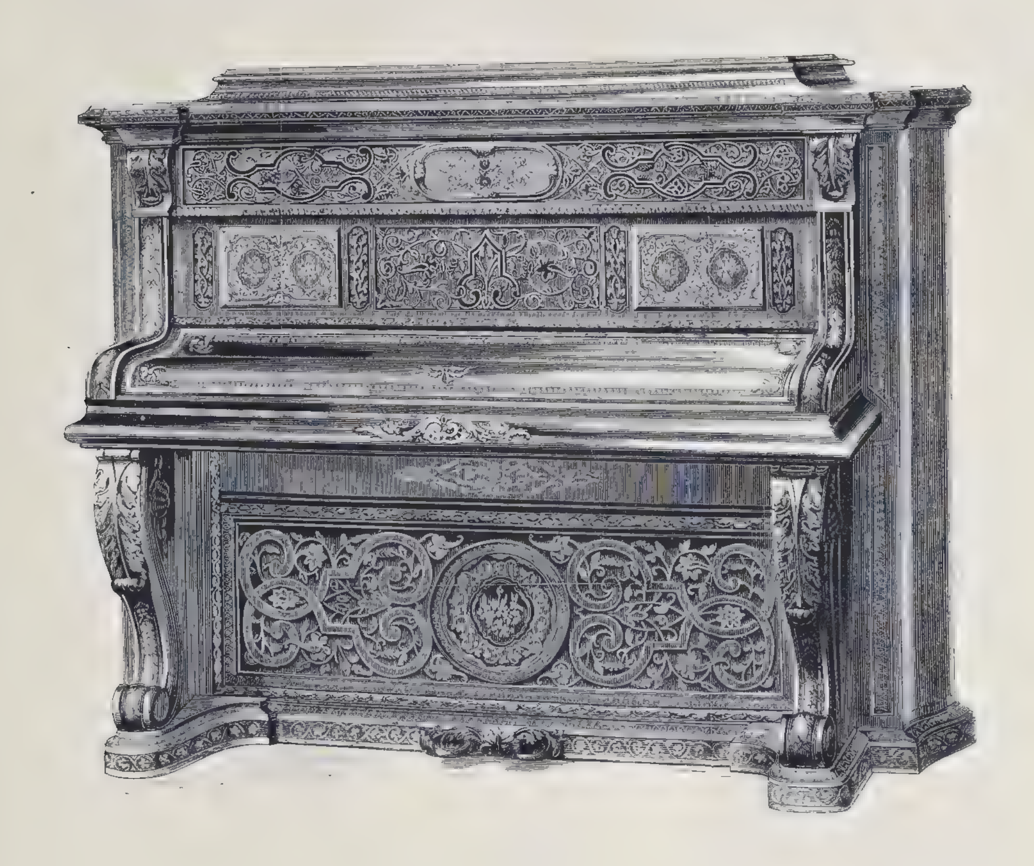




ENGLISH CARVED WORK.

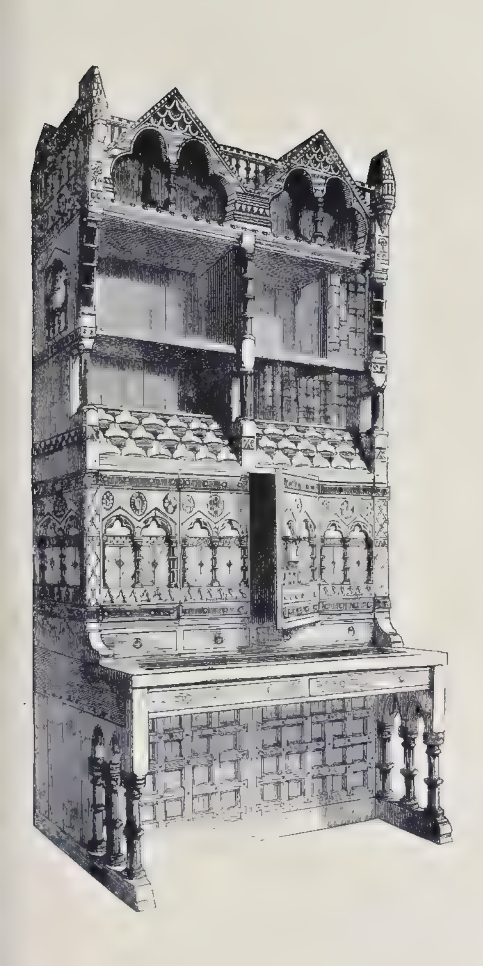
FIRST we have here a sumptuous piece of work by the eminent firm of Trollope and Sons, of London. a Sideboard worthy to stand in, and to decorate, the dining-room of a palatial residence: it is a work of very high character. admirably designed and superbly carved; in the Wine-cooler which accompanies it, the boars' and dogs' heads are most appropriately introduced in the grand garland of fruit and flowers. It was exhibited in 1862.

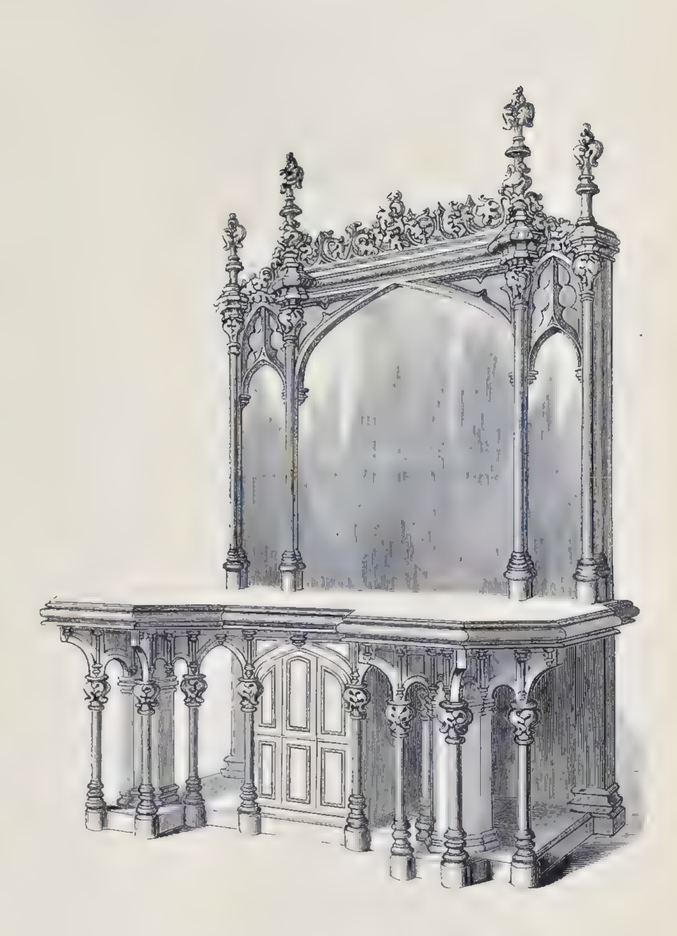
The other work represented on this page was one of the most admirable examples of its class shown by an English firm at the First Great Exhibition, and a remarkable specimen of the Elizabethan style; it was produced by Messrs. Cookes and Sons, of Warwick, and derives its principal subjects from the delightful novel of "Kenilworth." The bear and ragged staff formed the badge of the famous Earl of Warwick.



ENGLISH PAPIER-MÂCHÉ.

A PIANOFORTE in a case of papier-mâché, by Mr. John Bettridge, of Birmingham. Musical instruments do not come within the scope of this work except as furniture; but as ornamental furniture this certainly deserves notice. A few years since, decorative articles in papier-mâché were much in vogue, but, unfortunately, the great facility which this admirable, light, and durable material gave to excess of ornament and brilliancy of surface created a class of work which, at last, became absolutely distressing to the eye: glaring flowers in bunches, pretentious but ineffective landscapes, animals of all kinds, glittered with mother-of-pearl, foils, and flaring colours, and at length that class of papier-mâché came happily to an end. But the material has many recommendations, especially its lightness and fine surface, and when decorated with good taste is very effective and pleasing. The example before us is one of the most important and best that we have seen: it was exhibited in Paris in 1867.





ENGLISH REPRODUCTIONS OF OLD STYLES.

THE figure on the right-hand side represents a Sideboard in the later Gothic style, treated in a very novel manner, probably designed for a mansion of that period. Nothing is more promising than to see a departure from the common forms with an appreciation of old styles. Here, in place of the usual closed-in side and end panels, we have arcaded work, which not only produces a fine effect of light and shade, but also offers the opportunity of exhibiting several bold works of art, which must, however, of course be Gothic in style. It is the work of Messrs. Hindley, of London, who exhibited it in 1851.

The other work is an admirable adaptation of the Mediæval style by Mr. Norman Shaw, and designed by Mr. James Forster, sculptor, and Mr. Forsyth. It is executed in oak, and combines Bookcase, Cabinet, and Writing-Table.



FRENCH CARVED WORK.

A GOOD example of finely carved furniture illustrative of field sports, a handsome Cabinet for a hunting-lodge or a sportsman's room. It is very English in conception, but it is the work of a well-known Parisian *ébéniste*, M. Reballier. The emblematical ornamentation is carried throughout consistently, and the carving, especially that of the two graceful figures which support the upper portion of the work, admirable. The group which crowns the whole is full of spirit and well composed—the pointer and hare on the one hand, and setter and wild duck on the other. One of the figures already referred to represents hawking, the other has a fox-brush or other trophies of the chase in his hand. The four panels below are decorated with *cupidons*, to borrow a French term, representing the four seasons. The ornaments not belonging to sporting are, appropriately, fruit and flowers. The cabinet was exhibited in Paris in 1855.




ORNAMENTAL DETAILS.



OAK CABINET OR BUFFET, in the Flemish style. Date 1530-40.

COLLECTION OF DECORATIVE FURNITURE.—SHEET I.

A HIGHLY interesting loan collection of decorative furniture was exhibited at Gore House in 1853, from which the examples on this and the following five sheets were taken. The following notes are from a lecture and remarks by Mr. J. C. Robinson, F.S.A.

"Cabinet-making, or the Art of Furniture, if it may be so phrased, most frequently necessitates in its manifestations the co-operation of so many other arts, that it is difficult to treat of it otherwise than very discursively, though an investigation into the æsthetic conditions that regulate the union of utility and beauty in 'cabinet work' would doubtless result in the establishment of special rules and canons enabling us to view it as a concrete subject. The consideration of superadded decoration as it arises from, or is at variance with, constructional necessities—the influence of the characteristic expression of the materials employed, &c., would, if clearly formularised, have a direct and practical influence in guiding the inventive powers of the modern artist into the best channel for their legitimate development. . . . .

"Very scanty remains of antique furniture have come down to us. Of works in wood, as might be expected, we possess but the barest and merest relics. . . . .

"Generally, in the lighter and more graceful kinds of Greek and Egyptian chairs, we see a perfectly consistent and artistic use of the material, the natural expression and tendencies of which are allowed free scope: the legs and framing are, indeed, sometimes disposed in elegant sweeping curves which at first sight may seem somewhat antagonistic to the natural rectilinear tendencies of woodwork, but these curved forms are so arranged as to conduce to bodily comfort and stability of construction, and may have been suggested by the use and capabilities of the staves or small wood of such trees as the yew or the cypress. Every one must have noticed the constant occurrence of the legs and feet of animals as supports to furniture; these are conspicuous in all antique epochs. . . . .



ORNAMENTAL DETAIL.

OR-MOLU MOUNTING, from an Ebony German Cabinet. Date about 1630.

COMMODE, in Buhl and Or-Molu. Date about 1700.

ITALIAN BELLOWS. Date about 1587.

FRENCH COFFER AND STAND, in Buhl. Date about 1700.

VENETIAN STATE CHAIR. Date about 1570.

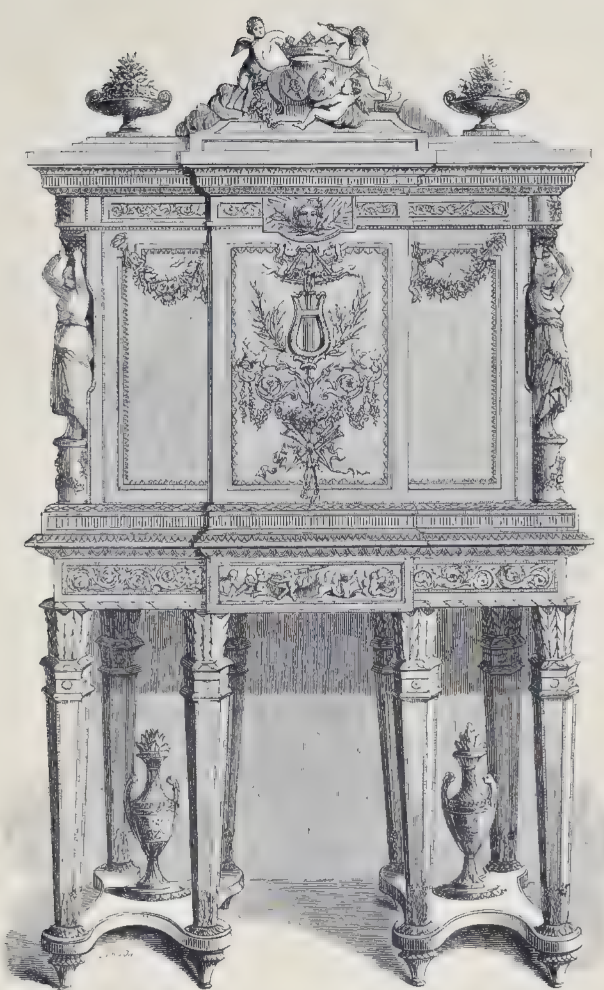
FRENCH ENCOIGNURE, in Buhl. Date about 1740.

COLLECTION OF DECORATIVE FURNITURE.—SHEET II.

"That wooden furniture was frequently painted and gilded, we know from numerous Egyptian remains; and we have fragments of ornamental mouldings in wood, of Greek origin, in the British Museum, which likewise exhibit traces of gold and colours. Marqueterie, or wood-inlaying, as is evident from many existing examples, was very popular amongst the Egyptians, and was doubtless equally well known to the Greeks and Romans. With respect to the employment of rich stuffs as cushions, hangings, &c., we have abundant evidence that their use was similar, indeed probably more universal than at the present day, for with the ancients drapery was an art. . . . .

"In Italy, during the fifteenth century, a greater diversity of processes is seen in furniture; already in that country the Renaissance had dawned, and various industrial arts, which had lingered on traditionally from the ancient epochs, were revived and greatly affected. Inlaid-work ('intarsiatura') became very popular; carved and incised ivory incrustation, veneers of rare polished woods, mosaics of glass and hard stones, gilded and lacquered wood-work, 'damasquinerie,' or metal-inlaying, and numerous other special decorative processes were now in frequent use, whilst the looms of Venice and Genoa furnished the costly upholstery stuffs for all Europe. In other countries, however, as we have seen, relief-carving in simple wood was almost the only mode of decoration: and this simplicity of means, as a general rule, continued, indeed, till the close of the succeeding century.

"We now enter on the sixteenth century, the great age of the Renaissance, in fact the grafting of all that was beautiful, and genial, and intellectual in the antique developments on the complete and well-organized system of Christian Art—the expressional. From this happy union then there was no dead formalism, no tame copying of the antique, such as we see everywhere and are wearied of in modern times—precedent was the rich storehouse, not as since, the rigid controlling bar to all original expression. The Renaissance is probably on the whole more completely developed and more distinct as a style in furniture than in architecture. . . . .



FRENCH CABINET, in Mahogany and Or-Molu. Date 1770 -90.

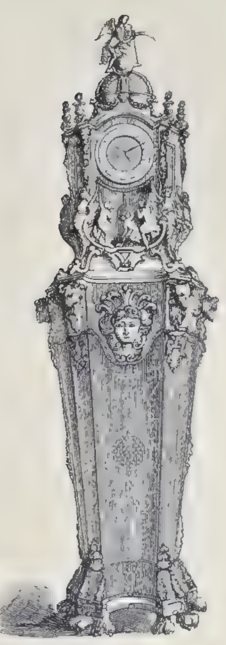
COLLECTION OF DECORATIVE FURNITURE.—SHEET III.

"In more than one specimen at Gore House we see columns, architraves, cornices, and pediments—in fact all the great constructional features of a classical order, mimicked on a small scale, and in inconsistent position, in wood. In a great ebony cabinet, for instance, we see columns with pedestals and entablatures complete, apparently supporting the upper part of the mass of the cabinet, which in reality are but ornaments attached to the doors, and open out along with them. It is not, however, in the outset that such mistakes as these were commonly made; a reference to the collection will demonstrate that nearly all the earlier specimens of the Renaissance are comparatively free from these drawbacks, which are only offensively manifested in the more pedantic period of the decadence of Art in the seventeenth century. . . . .

"In order to characterize as far as possible sixteenth and seventeenth century work, it will perhaps be advisable to take for illustration some one of the more prominent articles of furniture in use in those periods, and the cabinet seems best calculated to answer this end, for on this favourite article the utmost luxury of decoration was generally lavished, until indeed at last it was looked upon rather as a work for show than use. The Germans, in the early part of the seventeenth century, had even a distinct and sufficiently expressive name for the decorative cabinet—it was called 'Kuustschrank,' or 'Art-cabinet.' The cabinet, properly so-called, seems to have come into vogue in the first half of the sixteenth century; the early specimens were generally of oak, in most cases elaborately carved. Somewhat later in date (1560-70) is a cabinet belonging to the Duke of Hamilton, of Italian origin—here we have a different and most gorgeous development. It is of wood, encrusted with iron plates, elaborately embossed with figure subjects, and intricate arabesques, inlaid with gold, forming the process called 'damasquinerie.' Works of this kind, though of such very costly workmanship, were much in vogue, and were chiefly of Milanese manufacture. Another prominent fashion was that of cabinets in oak or ebony, inlaid with plaques of ivory, on which beautiful arabesques and figure subjects were engraved, the lines of the engraving being blackened as in niello work. Next, perhaps, come the works in 'pietra dura,' or cabinets inlaid with a beautiful mosaic, composed of precious stones, agate, jaspers, &c., which are chiefly of Florentine manufacture, and were more especially in



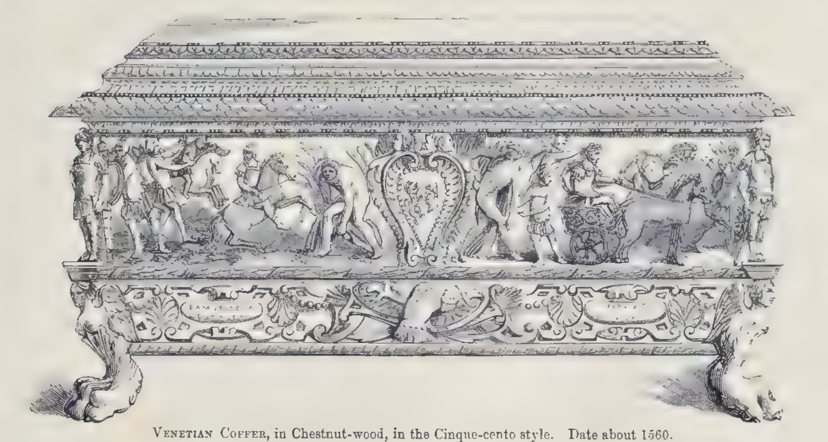
A Tulip-wood Table, inlaid with Sèvres Porcelain.



Clock and Terminal Pedestal, in Buhl. Date about 1700



Venetian Stool. Date about 1670.



Venetian Coffer, in Chestnut-wood, in the Cinque-cento style. Date about 1560.

COLLECTION OF DECORATIVE FURNITURE.—Sheet IV.

vogue in the beginning of the seventeenth century. After these we have the carved ebony cabinets of Holland, Germany, and France. . . . . Next we find metal enrichments in great vogue, generally appended to work in ebony. . . . .

"About this period (1630-50) we see the first dawnings of the system of 'incrustation,' afterwards so popular in the well-known 'Buhl-work;' at this time, however, a habit of unbridled profusion of all kinds of rich materials began to prevail, a fragmentary heaping together of which, although it produced a rich and gorgeous general effect, annihilated all consistency of style; in short, a chaos of indiscriminate elaboration took the place of art and unity of design. Out of this, however, arose a new and original phase of things; with the reign of Louis XIV. came, as it were, another Renaissance. France superseded Italy as the country of the Arts, and Paris became the centre of fashion, and the chief source of all decorative novelties. We now find every variety of secrétaire, commode, encoignure, coffer and stand, couches, fauteuils, clocks, guéridons, and tables of all kinds: in short, the special age of furniture has arrived. . . . .

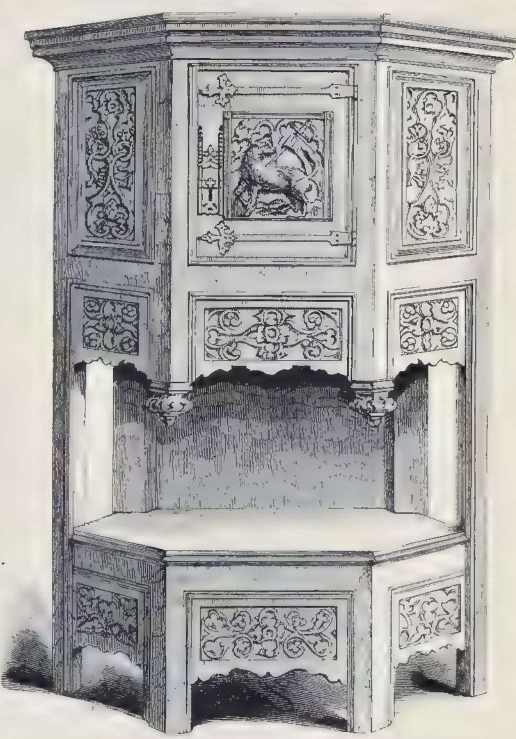
"As a general rule in furniture, rectilinear forms and flat surfaces are now superseded by every variety of capricious inflections of rich surfaces of marqueterie, rare polished woods and inlays; this curvature, apart from the mere desire for variety and novelty of form, being evidently prompted by the wish to display to the best advantage the rich materials employed, and to secure the general brilliant effect of the piece. The almost universal use of *appliqué* metal enrichments naturally modified all the constructional lines of the several pieces; curved and broken leading lines, salient points and undercuttings, and general ductility of appearance, constituting the natural characteristic features of metal-work. The shell and the scroll, masks, garlands, cartouche, and strap-work, were no longer confined to panels, pilasters, fasciæ, or the pediments



Detail of Oak Italian Cabinet. Date from 1520 to 1550.



Oak Buffet, in the Flemish style. Date about 1520.



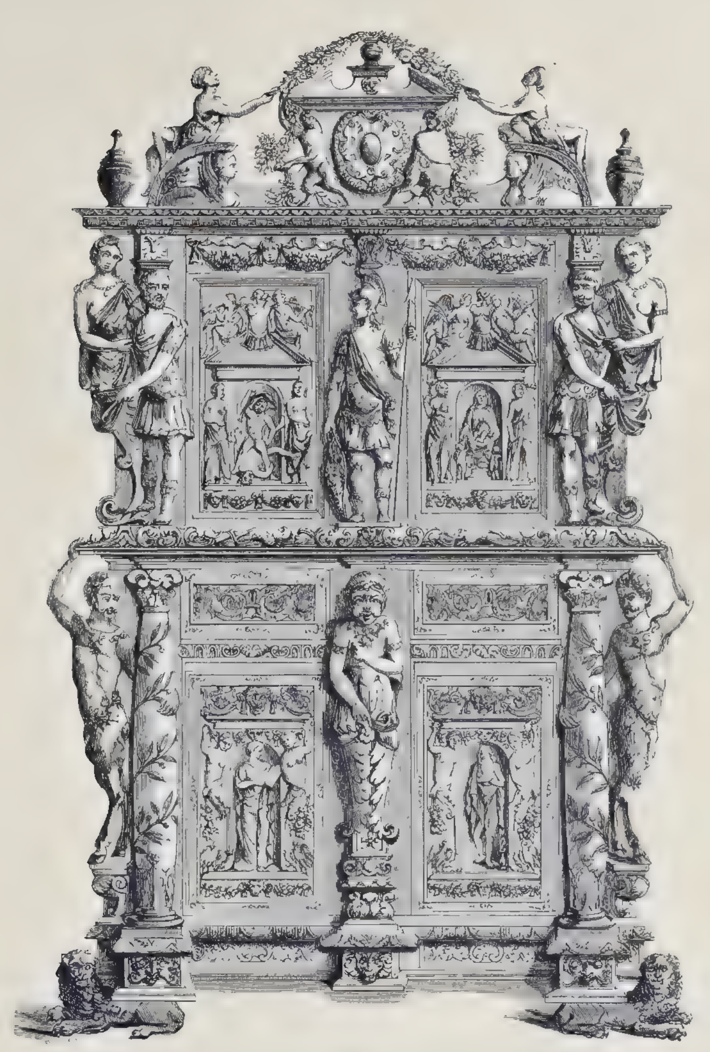
Oak Buffet, in the German Gothic style. Date about 1480.

COLLECTION OF DECORATIVE FURNITURE.—Sheet V.

of mimic architectural orders, as architectonic framework was no longer necessary. Colour, light and shade, abstract elegance of line and surface, agreeable disposition of space, and contrasts of material were aimed at; too often, it must indeed be allowed, at the expense of constructive truth, yet still with a genuine and original power of production not equalled in the present eclectic age.

"The furniture of the Louis-Quatorze epoch, alike French and Italian, may be briefly characterized as of three leading kinds. First, carved and gilded objects; secondly, veneered furniture in marqueterie, or inlays of rare and artificially coloured woods; and thirdly 'incrustation,' or, as it is more commonly called, 'Buhl-work.' This last is perhaps after all the most original and characteristic development of this age. Inlays of metal work in wood we occasionally see in the earlier part of the seventeenth century, but this system seems to have attained prominent vogue not much earlier perhaps than 1660-70, and there can be little doubt but that the specific development in question was the invention of the celebrated industrial artist whose name it bears—Charles André Buhl (born 1642, died 1732), cabinet-maker to the king. At this period, however, every conceivable application of materials and process of manufacture were freely employed, and by the end of the seventeenth century nearly all the well-known varieties of decorative furniture were in vogue, except perhaps two rather prominent modes, which belong to the next century; these are Japan work, often insertions of real Oriental productions, which became popular in the earlier years of the eighteenth century, and the elegant kind of furniture in precious wood, inlaid with plaques of painted porcelain, which was of still later introduction. Holland, Germany, and more especially Venice, became famous for their beautiful manufacture in cabinet work during this period, although France undoubtedly maintained the first rank in this respect.

"In England, a great impetus to the production of decorative furniture was doubtless given by the gay, luxurious reign of Charles II., at whose accession a flood of Continental fashions were introduced; much of the state-furniture of our old



French Cabinet, decorated with Distemper Paintings   Date 1570-90.

COLLECTION OF DECORATIVE FURNITURE.—Sheet VI.

mansions of this period was, however, evidently imported; and, generally speaking, furniture of undoubtedly English origin will not bear comparison with the fine specimens of foreign manufacture. In the reign of Charles II., however, a vigorous and most artistic style of wood-carving sprung up in England. The works of Grinling Gibbons at this period would bear comparison with those of the most able Continental wood-carvers, and the peculiar style brought into vogue by this celebrated artist and his contemporaries was prominently developed and extended in the earlier years of the succeeding century: English rococo-carving in wood being often distinguished by marked originality, and a well-defined national bias. The works of Chippendale, a famous cabinet-maker of St. Martin's Lane, exhibit very great merit. . . . .

"In the first half of the eighteenth century the characteristic style is the 'rococo,' which is merely a still more florid and extravagant development of the previous mannerism, characterized by a picturesque irregularity of detail, scorning all rules, making use of all motives, natural, conventional, or utterly monstrous, as the case may be, without the slightest concern at the innumerable violations of common sense even, which are of constant occurrence. Beautiful and masterly manipulation in all kinds of Art-workmanship has reached its highest pitch, and with it the series of genuine and original styles in ornamental manifestations may be said to have closed; after this commences the mania of revivals. There was perhaps some vitality in the phase of style known as the 'Louis XVI.,' of which the splendid Cabinet by Goutier, belonging to her Majesty, here given, is a fine example, but the rage for the revival of classical ornament soon put an end to all genuine motives. The cold and rigid formality of the period of the Revolution and the Empire in France was perhaps the very falsest period of the decorative arts that the world has yet seen, and as France, even then, was the great arbiter of style and fashion, a kindred revolution in taste took place with greater or less completeness in almost all the other European countries."



FRENCH CARVED OAK WORK.

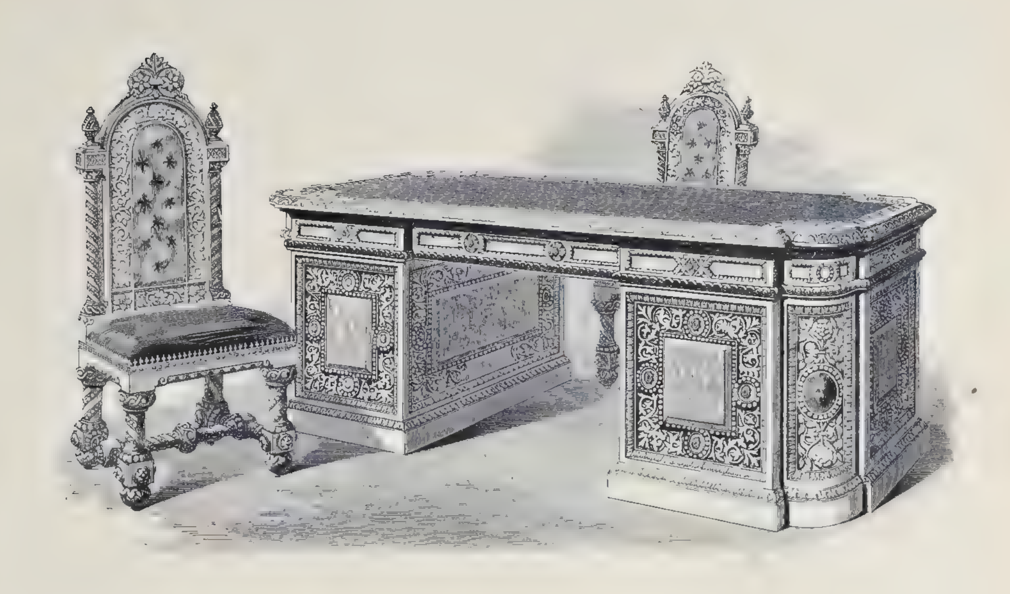
AN elegant carved oak Cabinet by the well-known firm of Pecquereau Père et Fils, of Paris: simple and graceful, it is very pleasing to the eye and tells its own tale. The interweaving of the foliage between the architectural ornaments above is a novel idea charmingly carried out. The beautiful examples of the potter's art are by another well-known Parisian house, that of MM. Rousseau. It is a pity that any handsome piece of furniture should be exhibited with empty shelves; here we see at once the intention of the designer, and are able to form some opinion of the amount of success he has achieved; and we think we may say in the present case, that while we have a beautiful example of decorated furniture before us, its decoration is, as it should be, quite subservient to the brilliant productions it is intended to contain and to exhibit as advantageously as possible.

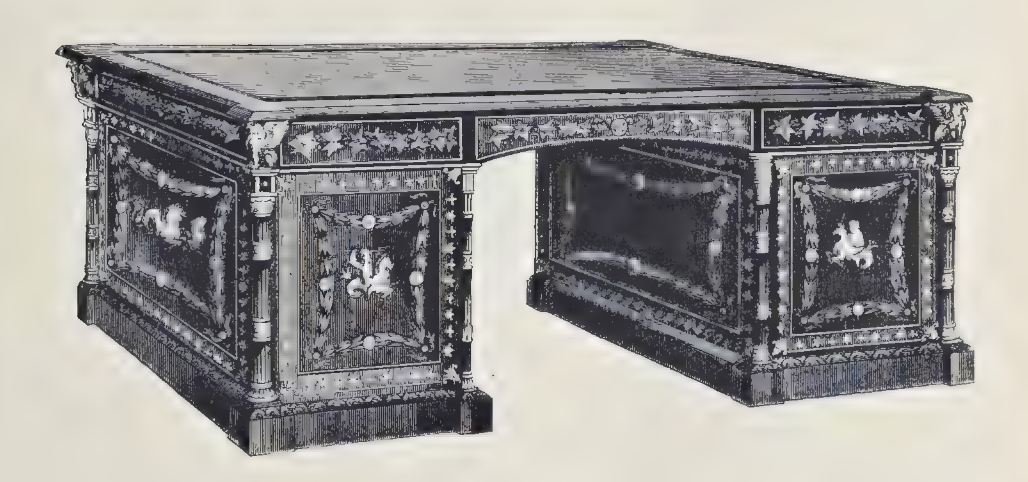


LONDON HIGH-CLASS CABINET WORK.

THE figure above and that towards the right hand represent the cornice and one side of a Bookcase, manufactured, and exhibited in Paris in 1855, by Messrs. Holland and Sons, of London, from the design of Mr. J. K. Colling, architect, and which forms part of a complete set of library furniture executed in wainscot oak, and inlaid with polished English oak, malachite, and Irish marble. The style is that of the Renaissance, but modified so as to produce a more chaste and unobtrusive effect than is often characteristic of that style: the object has certainly been attained.

The handsome Wardrobe is the production of Messrs. W. Smee and Sons, who exhibited it in 1862: it is a very delicate piece of work, executed in birch wood inlaid with tulip wood and delicately carved.





LONDON CABINET WORK.

THE Table and Chairs shown above formed part of a fine suite of library furniture in wainscot oak, contributed by Messrs. Holland and Sons, of London, to the Paris Exhibition of 1855: the style adopted is that of the Renaissance, which is not often selected for works in oak, and Mr. Colling, the architect, who designed these handsome examples, has had the good taste to omit the grotesque animals and what is called the strap and cartouche work, both of which often run into unmeaning conventionality. The ornamentation which he has adopted is at once bold and graceful, and seems to us admirably suited for the purpose in view.

The other Table, contributed by Messrs. Howard and Sons, also of London, to the Exhibition of 1862, is in a style still less cultivated in this country than the former in the production of articles of this class, namely the Pompeian; the ornamentation is sunk below the surface of the wood, so that it is not in danger of injury, and the winged creatures at the upper corners and other of the most important details are executed in bronze richly gilt. Other pieces belonging to this handsome library suite, including the bookcase, will be found in our pages.





FRENCH AND ENGLISH SIDEBOARDS.

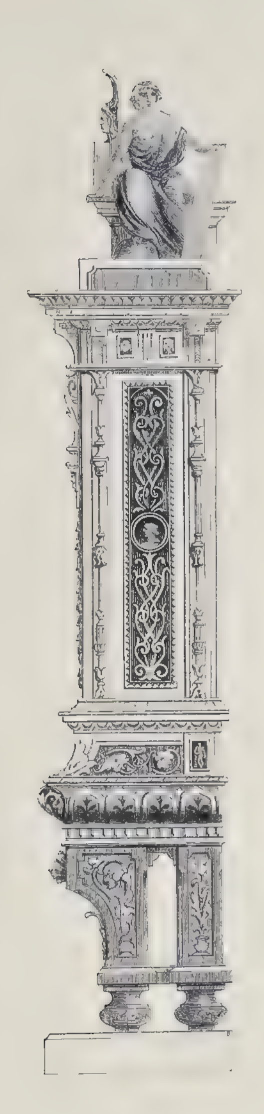
THE upper figure represents a magnificent Sideboard, shown by M. E. P. Durand, of Paris, at the 1851 Exhibition. This noble piece of furniture partakes somewhat of the character of the *dressoir* of Mediæval times, and the recess in the centre gives it great character, while the position of the clock is excellent. The whole design is thoroughly architectural, and the details both of construction and ornamentation are in perfect harmony.

The above has a thoroughly worthy companion in the handsome piece of work by Messrs. Jackson and Graham, of London, which occupies the other portion of the page. Here we have the same architectural sentiment, the same admirable fitness and propriety in all the parts, while the ornamentation exhibits some originality, as, for instance, in the floriated brackets which support the lamps. This was one of Messrs. Jackson and Graham's contributions to the Dublin Exhibition in 1853.



PARISIAN EBONY WORK.

A CHARMING example of the highest class ebenistery of Paris, exhibited by M. A. Chaix in 1862. It is a Cabinet intended to contain objects of *vertu*, and, being intended to stand in the middle of a room, is elliptical in form, so that the objects enclosed within it are seen to the fullest advantage: this form has further the recommendation of very graceful effect, and its novelty calls for special notice. The four chief figures, of which two are shown in the engraving, represent Poetry, Painting, Architecture, and Sculpture, and above the cornice are four smaller figures bearing palm and other branches. The whole is surmounted by the mythical wolf suckling Romulus and Remus, possibly the crest of the possessor. The design is remarkably chaste and elegant, and every detail of the work is carried out with great skill.

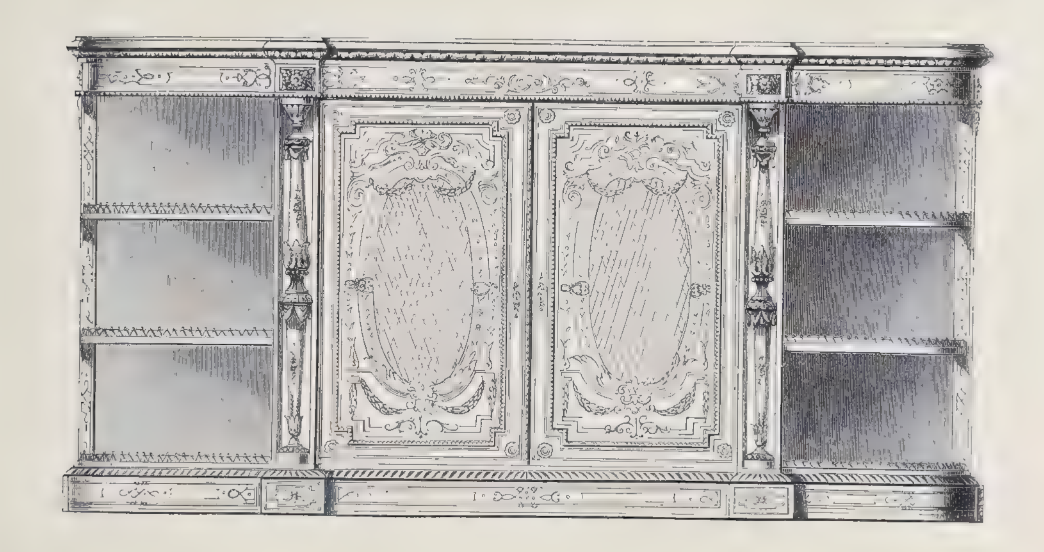




ENGLISH CARVED EBONY WORK.

A SUPERB Cabinet, contributed by Messrs. Trollope, of London, to the International Exhibition of 1862; a capital rendering of the Early Italian style. It is of ebony inlaid with various other choice woods; in the frieze are enamels by Messrs. Copeland, after the Limoges manner. Setting aside the incongruity of introducing the special features of an open-air structure, such as the triglyphs—an incongruity committed almost daily in a work to be most carefully protected from the weather, this is a superb piece of work, noble, massive, and elegant, and does infinite credit to its designer, Mr. Richard Beavis. It is a very complete piece of work, with its broad, effective ornamentation below—although the front legs seem to retreat too much—its graceful side-panels, and extremely elegant work above, with the fine figures as effective in a side as in a front view; the carving, and especially that of the upper portion, is remarkably fine, and emanates from Mr. Mark Rogers.





FRENCH AND ENGLISH INLAID WORK.

THE exquisite Cabinet above was one of the contributions of a perfect master in the art of producing decorated furniture —*meubles de luxe*, as our neighbours call such work—to the 1851 Exhibition, M. Fourdinois, of Paris, who has furnished us with many brilliant examples: the cabinet is constructed of ebony, the mouldings and prominent ornaments are of bronze gilt, and the panels are of tortoiseshell inlaid with brass Buhl-work. The grand beauty of this, like all the work of the truly *ébénistes* of Paris, consists in the exquisite harmony of all the parts and the unobtrusiveness of the ornamentation.

The other beautiful work, which is half cabinet and half *étagère*, the name used in France for pieces of furniture formed of several shelfs or stages for the exhibition of porcelain or other *objets d'art*, was a contribution by the eminent firm of Holland and Sons, of London, to the Exhibition of 1862, and is decorated in a style not much practised in this country. The work is formed of Australian "thuya" wood, and the marquetry ornament is inlaid with the rarest woods in their natural colours. Much inlay, the student should know, is coloured and fades sadly with age. As to the beautiful chaste design of this work, that speaks for itself.



ITALIAN AND ENGLISH EBONY, IVORY, Etc.

THE two most remarkable objects on this page, those which occupy the second line, are a square Table and a Curule Chair made by Signor G. Capello, of Turin, for the King of Sardinia; the elements of the designs are strictly Greek, and they formed conspicuous objects at the Great Exhibition of 1851. The ornamented portions are inlays of ebony and ivory, and every detail is finished with elaborate care and great skill.

In a totally different style, though in like materials, are the parts of an "occasional" and an octagon Table by Messrs. Trollope, of London, who have contributed largely to our collection. The design and execution of all their works are admirable; the present examples are in ebony and ivory. They were shown in 1867.

The elegant Writing-table which occupies the space between the preceding is the work of Herr Lovenson, of Berlin, and Mr. Yacoby, of London.

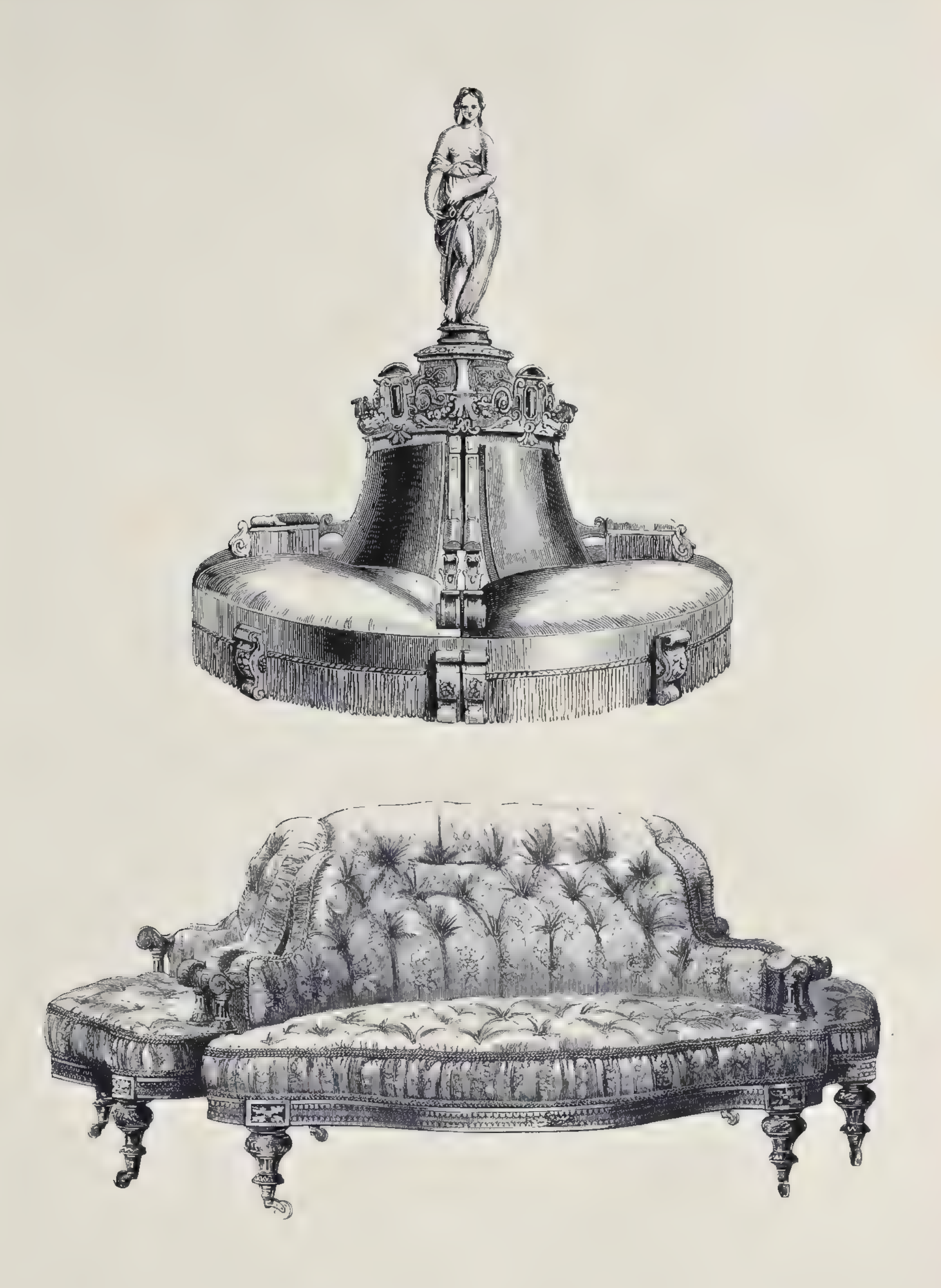
The smaller Table above in the centre is by Mr. Levien, of London, of whose excellent work we give several more important examples.



FRENCH CARVED WORK.

THE larger Cabinet here shown was the contribution of M. I. P. Jeanselme, of Paris, to our first Great Exhibition. It is composed of a fine dark wood, highly polished and enriched with carefully selected specimens of beautifully coloured marbles and stones, which give it a remarkably rich effect. That it is the work of a practised hand or hands is beyond doubt.

The other engraving represents a wing of a large Cabinet by Messrs. Gueret frères, also of Paris, who have achieved a high reputation as decorative artists, and especially for their wood-carving, which is of the highest character, applied with a thorough appreciation of fitness and executed with remarkable delicacy: their perfect command of very low relief, an extremely difficult requirement, is remarkable. The cabinet was one of the *chefs-d'œuvre* of the Paris Exhibition of 1867. Other productions of these talented brothers will be found amongst our illustrations.



FRENCH AND ENGLISH OTTOMANS.

THE Ottoman represented on the upper line is an example of happy application of artistic taste to what is commonly a not very attractive piece of furniture, although extremely useful in a large salon: without interfering in any way with the proper form of the ottoman as an object of utility, the artist, M. Baluy, has placed a most graceful figure on an elegant base.

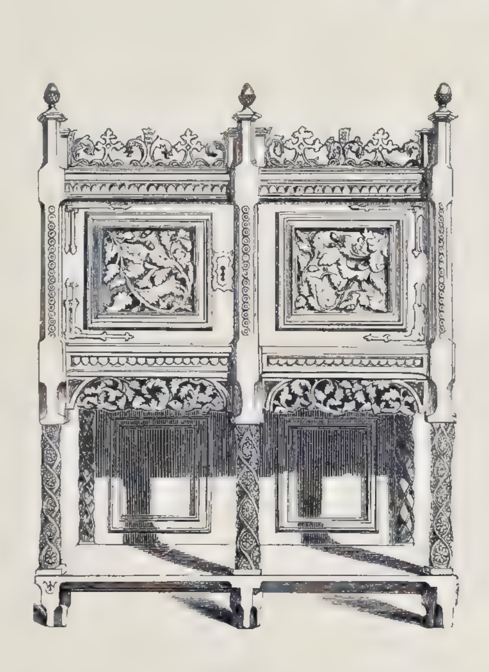
The other figure is that of a sumptuous Composite Ottoman, composed of sofas and arm-chairs, forming a fine object for the centre of a grand drawing-room, but capable of being separated and dispersed in an instant when required. It is an admirably designed and perfectly finished piece of work by Messrs. Filmer and Son, of London, who exhibited it in Paris in 1867.



MILANESE EBENISTRY.

MILAN had of old a great reputation for artistic workmanship, and it has not lost it in the present day. The magnificent Bedstead represented on this page formed part of a complete suite exhibited by Signor Rikamonti, of Milan, in 1862, and which called forth much deserved admiration: the style is pure Renaissance, superbly carried out, especially in the upper part, which is very remarkable; the effect of indicating two beds under one dais, as it were, perhaps rather weakens the general effect of this magnificent work. In black and white the beauty of the design and of all the details will be evident enough to the practised eye, but the beauty of contrast in colour cannot even be indicated. The wood employed is little known and less used; it is the beautiful walnut-tree wood of India, a richly grained and coloured wood, and the panels carved in bas-relief are of maple, while the effect is greatly heightened by chaste bronze mouldings doubly gilt. We give in another place one of the chairs which belong to this superb palatial suite of furniture.







ENGLISH MEDIÆVAL WOODWORK.

THREE admirable examples of British modern woodwork in Mediæval style shown at our first Great Exhibition, where the collection of such works formed a very prominent feature, and attracted great attention. It must be admitted that some of the contributions to the Mediæval Court exhibited exaggerations which were the natural result of zeal, fashion, whim, or whatever it may be called, outrunning knowledge and taste; but, on the other hand, there were many specimens which exhibited a deep and thorough knowledge of and feeling for the style of olden times, and at the head of the learned and skilful revivalists stood Welby Pugin, from whose designs Mr. Crace, of London, produced the very elegant Prie-Dieu at the head of the sheet and the Cabinet towards the left-hand on the lower line. The former of these is enriched with painting and gilding; the latter is executed in oak, designed with that boldness which characterizes the master, and both as regards the carving and the brass ornaments which enrich the work, the workmanship is perfection.

The companion Cabinet is another excellent example of the same class in the florid style by Mr. Myers, also of London, who was a large contributor to the Mediæval Court in the Crystal Palace in 1851.



PARISIAN EBONY WORK.

AN admirable example of the highest class and yet of great simplicity; the ebony is unrelieved by any colour, there is no metal work, gilding or any kind of decoration introduced, yet the perfection of style and gracefulness of every detail render it a work of very high Art, and the eye reposes upon it with infinite pleasure. One feature, however, we must not omit to notice, which is the introduction in the doors of beautiful glass with chamfered edges in the Venetian style, since become common in Paris. A novel feature in the way of construction is the introduction of shelves in the wings, open both in front and at the side for the exhibition of china or other objects of Art. This charming work is from the ateliers of MM. Jeanselme Fils et Godin, who exhibited it in this country in 1862.





ENGLISH DECORATIVE WORK.

THE engraving above represents a handsome Sideboard formed of various beautiful ornamental woods of New Zealand and carved with much skill. It is the work of Mr. J. M. Levien, of London, who, having lived in that colony and experimented on the wood of many trees indigenous to the island, introduced and used them largely here. Other works by Mr. Levien will be found amongst our illustrations.

The other engraving furnishes an example of composition work, papier-mâché or *carton-pierre*, on a wooden body, by Messrs. White and Parlby, of London, who have executed many admirable productions in these materials, but none that we know more important of its class than the elegant Cabinet before us, of which the design is beautiful and the execution excellent. Several smaller works of great beauty by the same firm will be found here.

Mr. Levien has recorded the date on his sideboard, and it applies to both these works.



FRENCH AND ENGLISH CLOCK CASES, Etc.

THE figure which crowns this page represents a grand bronze Clock Case by M. Victor Paillard, one of the first bronzists of Paris, and who has contributed many admirable works to our and other exhibitions. In this case M. Paillard seems to have set himself the task of showing how boldness could be produced without heaviness; the scroll-work below is unusually massive, but this is compensated by piercing the work; the group of boys and birds which surmount the whole has the grace and beauty which characterize all M. Paillard's work.

The Clock below towards the right hand is an eight-day lever escapement, striking the hours and quarters in fine-toned cathedral bells; the base on which it stands is of steel burnished and enamelled; exhibited by Messrs. Moore, of London.

The remaining figure represents a piece of work of much originality and beauty; it is a combination of a clock, dials showing the day of the week and month, inkstand, and all the necessaries of the writing-table, executed in metal beautifully engraved and otherwise ornamented, and gilt, by Mr. Cole, of London; a fine example of Clerkenwell work.

These three productions were all exhibited in 1851.



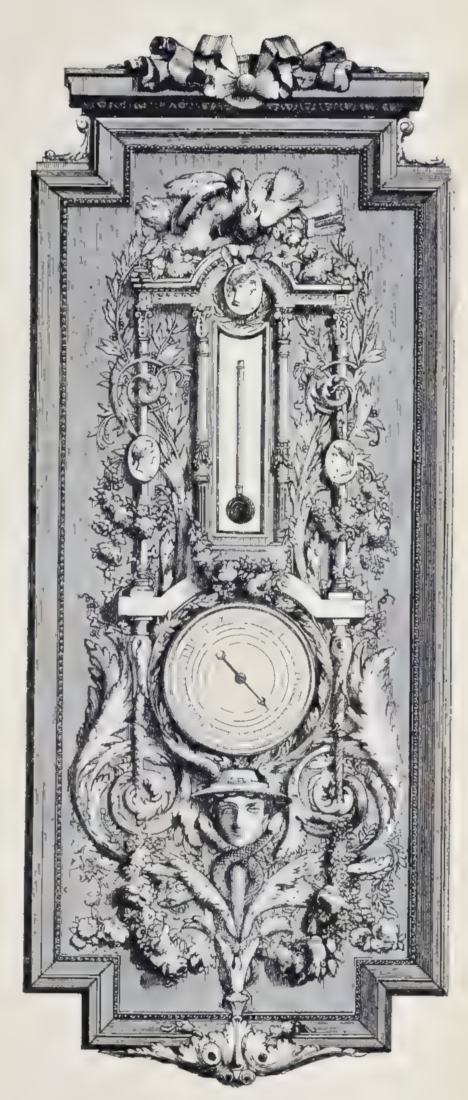


ENGLISH CLOCK CASES.

THE large Gothic work towards the right hand is an example of excellent design by Mr. P. H. Delamotte: it is admirably executed in carved oak, with crockets, crestings, finials, and side panels in polished brass: it was exhibited in 1862 by Mr. E. White, of London, and is equally creditable to the manufacturer and the artist.

Novel and very beautiful is the Case on the left hand, so sombre-looking in the printers' black and white, but widely different in reality. This charming piece of Art-work is from designs by Mr. Henry and Mr. Lewes Day; the woodwork is delicately carved. The dial presents the conventional brazen sun, with the sunflower above; the metal panels are decorated with daisies and grass, in the spandrels are the winged emblems of eternity, four painted tiles show the phases of the moon, and the three large porcelain plaques below are decorated with English flowers representing the seasons.





ENGLISH AND FRENCH CARVED WORK.

THE noble Cabinet towards the left hand is the work of Mr. A. Hayball, who was trained in the Sheffield School of Design, and exhibited this beautiful work in 1851, when the art of design was little developed in England. Mr. Hayball has here shown that he is not only an able wood-carver, which we believe is his profession, but that he had carefully studied Italian ornamentation, and knew well how to apply it. This is not the only good example of decorative work which appeared at the Great Exhibition from the pencil and chisel of students of the Sheffield School, and one or more besides will be found amongst our illustrations.

A Barometer and Thermometer Frame of great beauty by Messrs. Gueret Frères, of Paris, who were formerly pupils of M. Fourdinois, whose fame is European. The design of this charming work is in all respects admirable, and the execution of the carving scarcely to be surpassed; it is a splendid study for a young artist. It was exhibited at the Paris Exhibition of 1867, and purchased by the Emperor.



PARISIAN CARVED OAK WORK.

A MAGNIFICENT work, exhibiting an admirable rendering of the Greek style, and carving of the highest order. We are not quite sure to what purpose it is intended to be applied; it has the general form of a cabinet, but the Bacchic bas-relief in front, the bull's head, the amphoras, and the grapes point to the dining-room. Perhaps it is meant to exhibit plate or porcelain; but whatever its destination, it is a splendid piece of work, and reflects much credit on the artist, M. E. Vaudale Fils, who designed it, and MM. Mazaroz-Rebaillier, who produced and contributed it to our International Exhibition of 1862.







ENGLISH CLOCK CASES.

THREE Clock-cases, exhibiting remarkable diversity of style and treatment. That above is by Mr. (now Sir) John Bennett, of London, and exhibits good taste and bold carving, the whole well adapted to its purpose.

The very elegant object towards the right hand presents an admirable example of the work of the late Mr. G. Rogers, a wood carver of remarkable genius, whose works are the admiration of every connoisseur: the outline and all the details are extremely effective. It is a combination of Clock and Inkstand, and was exhibited by Mr. J. Hax, of London.

The third figure presents a charming example of rich naturalistic carving in oak by the same artist, also exhibited by Mr. J. Hax, of London.



FRENCH CARVING AND CARTON-PIERRE.

An example of one of those productions which sins against all the canons of Art, but which has and always will have hosts of admirers, for daring and cleverness are highly attractive. It is impossible to admit the propriety of masses of game cut out of wood or moulded in *carton-pierre* forming true ornamentation: a live stag, hare, or pheasant are exquisitely beautiful creatures; a dead stag, hare, or pheasant hung up by the legs is repulsive. Painters study dead game for colour and texture, and they do well, but in wood-carving and modelling of any kind these important qualities, or at any rate the former, cannot be rendered. However, as long as imitations of dead animals are admired they will be produced, and in spite of our own protests we can admire the bold drawing and admirable execution of this example, and especially the treatment of the story of Saint Hubert which fills the oval panel above, and that of the charming group of children below busy with the golden corn. This sumptuous piece of decoration is the work of M. Cruchet, of Paris, and was shown at the first Great Exhibition.



ENGLISH CARVING AND GILT WORK.

ONE of the most elaborate and richly gilt examples of the kind at the Great Exhibition of 1851: the Console Table and Glass Frame are carved in American pine and lime-tree wood, and double gilt in matted and burnished gold. The style is a variation of that known as Louis-Quatorze; the introduction of figures of birds, fabulous winged horses and other creatures amongst the ornamental work has an excellent effect. It is the work of Mr. S. Lecand, of London, and executed in his best manner.



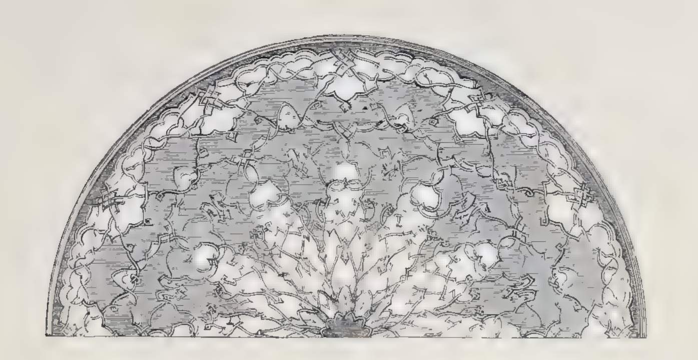
ENGLISH AND FRENCH ORNAMENT.

THE figure at the top, towards the left-hand, represents the elegant upper part of a Console Glass, by Mr. Morant, of London, who, however, has supplied us with several other and more important examples.

That next beneath it is the top of a carved Wardrobe, in the Italian style, executed in rosewood by M. Joly-Leclerc, of Paris.

The Watch-stand below is in Irish bog wood and silver, and was presented by the students of the Belfast School of Design to their President, Lord Dufferin, in 1853: the stand was designed and the group which surrounds it modelled and cast by Mr. J. B. Williamson, then head pupil in the school.

The two Barometer Cases are the work of Messrs. Gray and Keen, of Liverpool; that above is executed in English walnut-tree wood and in Florid Gothic style, the other was designed for the Sailors' Home, in Liverpool, the main portion of the framework being a facsimile of a patent anchor.





AUSTRIAN AND ENGLISH DECORATED WORK.

THE splendid Clock here represented was shown by Messrs. Howell and James, of London, at the Great Exhibition of 1851. It was intended for a drawing-room, and executed in ormolu in the best manner from the design of Mr. Adams, an artist of talent. The outline in scroll-work is original and bold, the ornamentation of the base in excellent taste, and the figure-subjects are far above the usual ornamentalist modelling. The two groups which occupy the upper angles are intended to symbolize Childhood, Girlhood, Maternity, and Old Age. The four small groups below represent Spring, Summer, Autumn, and Winter.

The Table of which half the top is shown above was manufactured by Herr Michael Thonet, of Vienna; the complicated and original design is beautifully inlaid with woods of various colours, and the construction of the table presents peculiarities deserving notice: the top of the table lifts up and presents a hemispherical cavity below, formed of rose-wood so disposed that the grain invariably follows the shape, this giving the wood its maximum value in strength and elasticity, that is to say, using the smallest possible quantity of it; the legs also are bent out of the solid. The outlines of the form of the table are marked by delicate inlaid lines of brass.



FRENCH CLOCKS, Etc.

THE larger of the two Clocks here shown is a fine specimen in bronze by M. Detouche, of Paris. It is novel in form and exhibits remarkable taste in the design of the decorative portions, especially that of the upper part, and that perfection in modelling which distinguishes the Parisian bronzists. The two figures pointing upwards indicate the flight of time.

Totally different in style is the other Clock, also in bronze, by M. Vittoz, of Paris: three beautifully modelled figures on a plinth of charming simplicity, supporting a starry sphere. Bronzes of this class are designed and executed in such a manner in Paris that they really belong to sculpture rather than to decorative furniture.

The beautiful example which occupies the top of the page represents the back of a Sofa, designed and executed in the very best style of Italian Art of the purest type. It is the work of M. Jeanselme, of Paris, whose works have supplied us with other admirable illustrations.



FRENCH EBONY AND CARVED WORK.

ON the left hand we have a magnificent example of ebony work in the style of the Renaissance, contributed by MM. Christofle, of Paris, to the Vienna Exhibition. The columns and pilasters on which it is mounted have capitals and *appliqué* ornaments in gilt bronze; the door is also of gilt bronze, with an exquisite head in translucent enamels in the centre. Within is a jewel coffer in steel, damascened, and drawers encrusted with a new preparation resembling ivory: the ornamentation on the other parts of the work are strictly in keeping and auxiliary to that of the principal panel, and present good specimens of cloisonné and bronze work, chasing, inlaying, damascening, and enamels—producing an effect of extreme richness. This rare work was designed by M. Rossigneux, architect; the enamels by M. F. de Cowrey, the figures by M. Mathurin Moreau, and the ornaments by M. Berger.

The sumptuous example of carved work towards the right hand appeared at the Paris Exhibition of 1855; it is a Gun Cabinet executed by M. Jeanselme, of that city, for Napoleon III. The ornamentation all naturally belongs to sporting, the dogs are life-size, and these and every portion of the carving are executed with remarkable skill.



ENGLISH AND SCOTCH SIDEBOARDS.

THE Sideboard engraved above appeared at the Great Exhibition, and was produced under remarkable circumstances by a young working-man of Sheffield, named Hoyle, then a student of the School of Design of that town, and compelled while producing this beautiful piece of work to maintain himself by working three days a week at one of the trades of the place. To have achieved such a result as that before us proves that Mr. Hoyle possessed not only extraordinary perseverance, but much natural taste, for there is no amateur or patchwork appearance. The proportions of the sideboard are good, the ornamental parts admirably disposed, and the figure and scroll-work prove that the designer had carefully studied the human figure and also the Italian style of ornament.

At the second of our great exhibitions, the improvement exhibited in the case of decorated furniture and other manufactures bore ample testimony to the value of such exhibitions, especially in the case of applied Art; the first showed us how greatly we were in arrear of our nearest neighbours, the second how rapidly we had advanced upon them. The handsome Sideboard given below is by Messrs. Whytock, of Edinburgh. Here we see admirable carving artistically applied, with due consideration for all the lines of the work; it is only when ornament is thus applied with discrimination that we get true Art-manufacture, in contradistinction to decorated work.



FRENCH AND OTHER DECORATIVE FURNITURE.

THE superb Cabinet which occupies the greater portion of this page is an admirable example of the employment of light and dark woods—ebony and pear-tree—rarely introduced into the same work, but here brought together with excellent effect, the whole being conceived and executed with masterly skill. The design of this beautiful work is by M. Lienard, and the execution by M. Ringuet Leprince, both of Paris, other examples of whose talents will be found in this work. It was exhibited in 1851.

We take advantage of the space on the right-hand side of the page to give two charming specimens of the taste and workmanship of Messrs. Poole and Macgillivray, of London, and more important examples will be found amongst our illustrations.

The Gothic Chair below is a small example of the numerous and beautiful works of Messrs. Lövenson, of Berlin, and Jacoby, of London.







ENGLISH AND SWEDISH BEDSTEADS.

THE engraving on the upper line is of a magnificent Bedstead, exhibited in 1851 by Messrs. Rogers and Dear, of London. It is executed in choice walnut-tree wood; the footboard is boldly and effectively designed, and the general effect is admirable. It should be observed that the designer has avoided a very common fault—that of introducing ornamental details where they would be hidden or inconvenient. This gorgeous bedstead is as comfortable in appearance as any common one—which too frequently is not the case.

Below on the left-hand side a small figure represents the foot of a Bedstead in varnished pine, by Messrs. Dyer and Watts, who have given much attention to this class of work. When the pine or any other wood—such, for instance, as maple, yew, &c.—is carefully selected, and the parts well put together, the result is infinitely better than can be obtained by coatings of paint, however carefully applied. The decorative work, in the case of pine furniture, is executed in dark-red colour with admirable effect.

The third engraving represents the foot of a handsome Bedstead, executed in oak by Mr. C. K. Edberg, of Stockholm, the design being by an eminent architect of the same city, Mr. E. Jacobson.

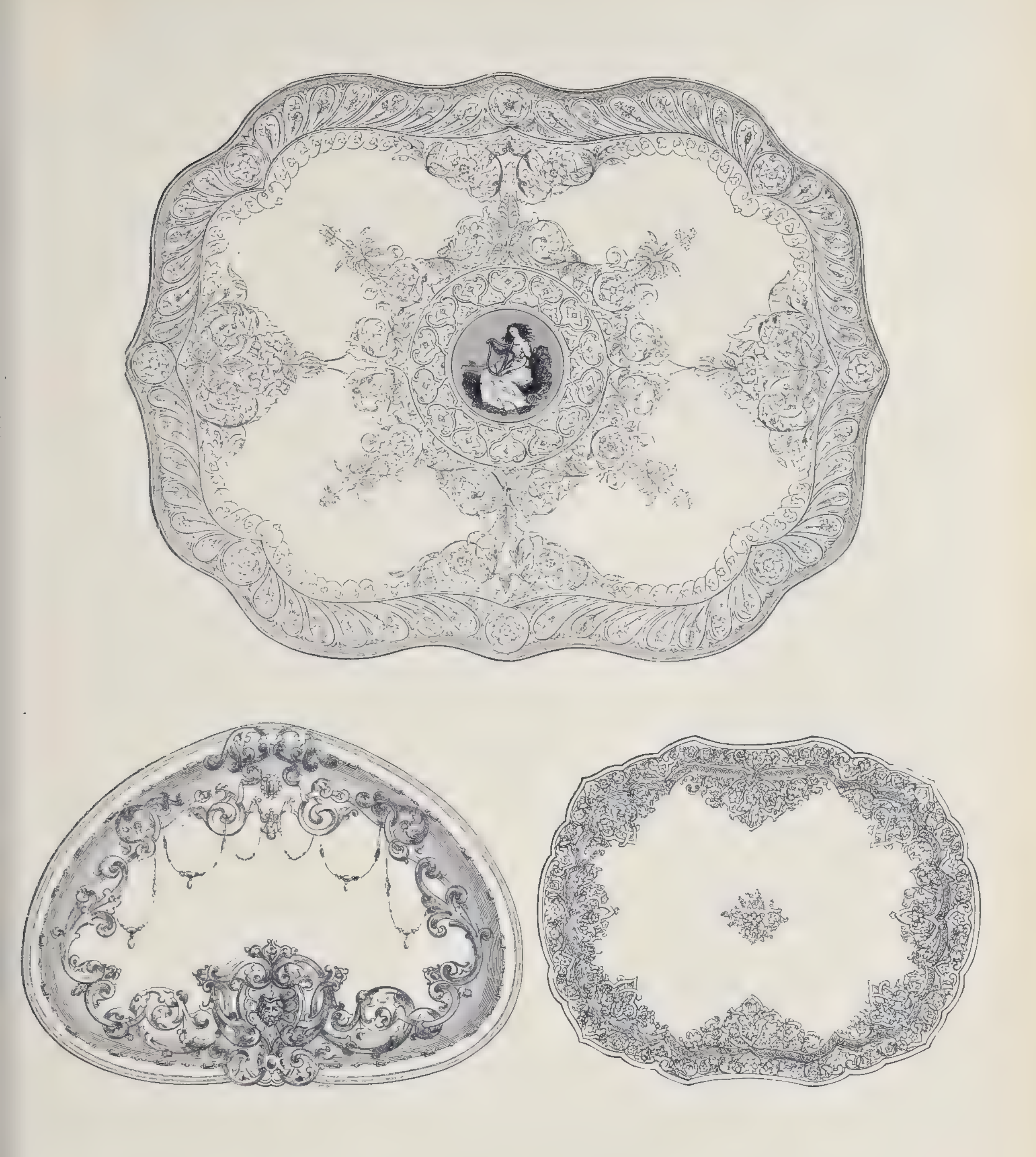




LONDON CARVED WORK.

THE magnificent Sideboard towards the right hand represents one of the contributions of the eminent firm of Jackson and Graham, of London, to the Great Exhibition. The elaborate design has been constructed with great knowledge and skill, and executed with much ability; it was certainly one of the most remarkable pieces of decorated furniture on the British side of the Exhibition.

The smaller engraving represents another of the beautiful objects which we have selected from the productions of M. Fourdinois, of Paris, whose sculptured cabinets have raised wood-carving to a Fine Art. The Cabinet before us was produced specially for England, and was shown at the International Exhibition of 1862. M. Fourdinois has not only raised the level of his art, but he has introduced improved modes of working which may have considerable influence. Where he desires to produce variety in colour he deals with fine picked solid wood, as the mosaist or inlayer does with thin veneers; that is to say, the designs are cut out with the fret saw, and the detached portions of one kind of wood inserted in the interstices of the other. In addition to this, one or more of the inlays are carved, so that variety is obtained not only in design, colour, and grain, but in relief also. There is a grand cabinet by M. Fourdinois at South Kensington, which illustrates this new method admirably.

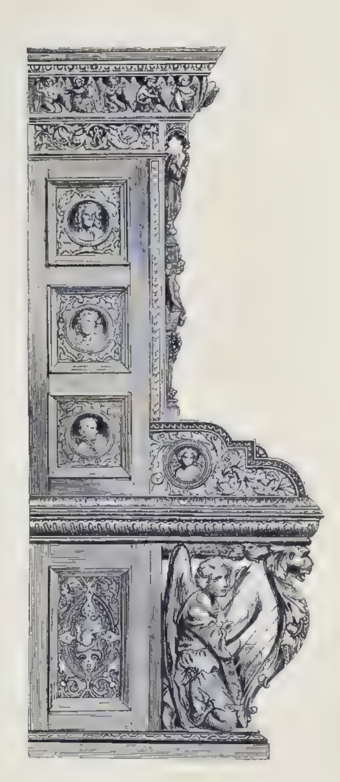


ENGLISH PAPIER-MÂCHÉ.

THE large Tray represented above was manufactured especially for Ireland by Messrs. Jennings and Betteridge, of Birmingham, and shown at the Dublin Exhibition in 1853; the decoration, which is at once elaborate and tasteful, is composed of the emblems of the three kingdoms, the shamrock predominating; in the centre is a cameo painting of the genius of Ireland.

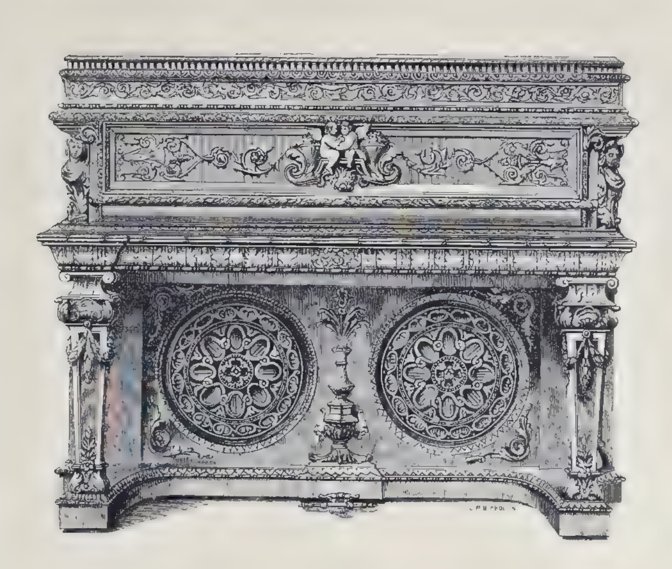
Of the two elegant Trays below, that on the left hand presents a charming application of the Renaissance style by Messrs. Walton & Co., of Wolverhampton, on whose works we have already laid some stress; the other, of which the decoration is most appropriate and elegant, is by Mr. H. Clay. They are examples of the highest class of papier-mâché productions.



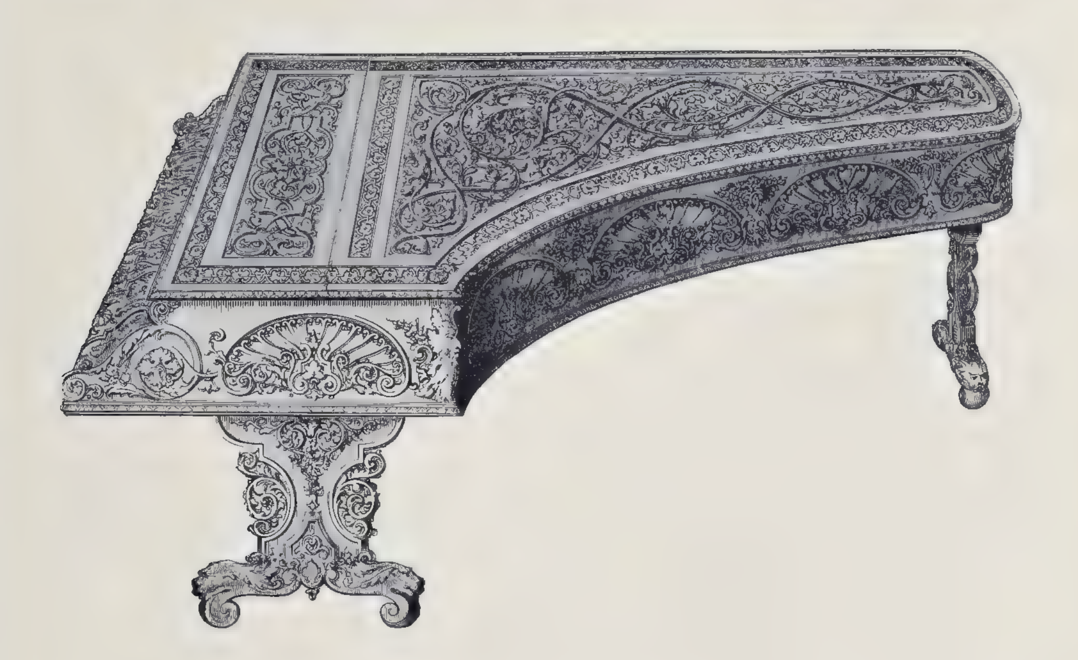


ENGLISH OAK PIANO CASE.

A HIGHLY decorated Pianoforte in light-coloured oak by Messrs. Allison and Son, of London. The treatment is peculiarly bold and happy, and the instrument presents that importance which is required in a large and handsome apartment. The carving is elaborate, but peculiarly appropriate, all the subjects, from Saint Cecilia in the central panel to the winged children in the frieze, the medallions, and other ornaments, having relation to music. The harp is very nicely introduced below. This beautiful piece of work was shown at the International Exhibition held in London in the year 1862, upon which epoch our illustrations now enter.







ENGLISH PIANOFORTES.

THE very beautiful upright instrument of which front and side views are given above is the production of Messrs. Collard and Collard, of London, and it is worthy of the high reputation of the firm. The design and ornamentation of the case of this superb instrument are very remarkable. In spite of the lavish beauty of the carving, the effect of the whole is extremely chaste; every bit of work seems to be exactly in its place, and a delightful harmony reigns throughout.

The other figure represents a case in solid East Indian rosewood, designed by Messrs. Joseph Kirkman and Son, of London, and executed by native workmen in Madras. The whole of the carving is "grounded out"—that is to say, sunk into the wood, as it should be in all large flat surfaces of articles intended for real use. The French carvers produce light sunk carved work on their cases very sparingly, with exquisite effect. The skill of the Indians in carving is very remarkable, as the numerous works which have been seen in this country prove beyond question; but a grand mistake has been made in sending out English designs to be carved in Indian fashion, the result being productions unworthy of any but a half-savage country. Here, however, we have a very different result—a purely European design in all its minutiæ, but executed by Indian carvers, and the result is excellent.



ENGLISH JAPAN AND PAPIER-MÂCHÉ WARE.

THE most important example given on this page is the large Tray below, decorated in the Alhambresque style. It is the work of Messrs. Walton & Co., of Wolverhampton, who are not only producers of Japan and papier-mâché ware of the highest quality, but who induced the late Owen Jones to employ his talent in raising the level of the decoration applied to such articles as these before us: the design of this tray is, we doubt not, by the late famous artist.

The Water-Can and Vase to the right of the reader are also by Messrs. Walton & Co., and are good examples of their general Japan ware, or, as it is termed in Wolverhampton, "Light Iron Ware." This ware is peculiar, from the application of a patented process by which the metal is secured against oxidation: this consists in covering the surface with a coating of white glass or enamel finely powdered and mixed with water, and then fused at a white heat, giving the surface of the articles the same appearance as that of fine earthenware.

The two smaller Trays are in papier-mâché, the upper being by Messrs. Knight, Merry & Co., and the other by Messrs. John Betteridge & Co., both of Birmingham.



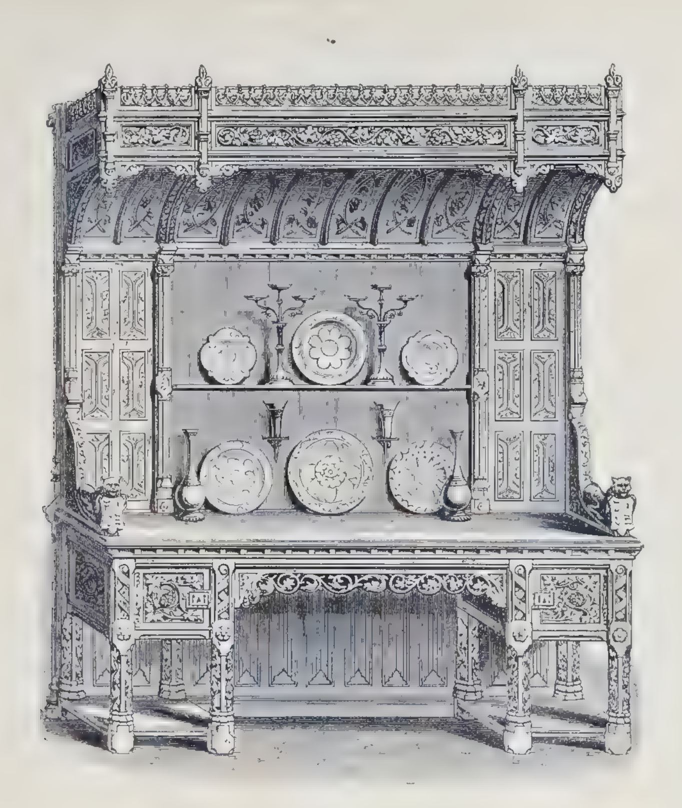
ITALIAN AND ENGLISH CHAIRS.

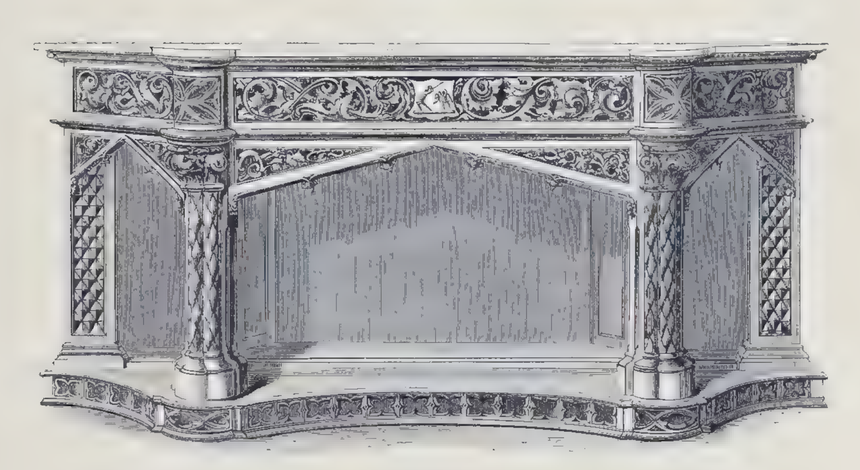
A CHAIR is not a satisfactory article for the cabinet-maker, a modern-shaped chair especially. The four legs must be set in a particular manner, and the back so arranged that the sitter be not in danger, by a careless movement, either to be thrown on his back or on his nose. Nothing is more common in light chairs than the tendency to fall forward when the sitter bends in that direction, and the necessity which thus arises for spreading the legs renders it very difficult to work them into a graceful design.

The form of chair which occupies the superior central place here is not open to the same objection. This Mediæval form has compactness, but to make such a chair safe it must be weighty and well poised as regards the back. The chair in question belongs to a magnificent suite of bed-room furniture exhibited by Signor Ripamonti, of Milan, and few specimens of purer and more beautiful Italian Renaissance were ever produced in that city, so famous for manufactures of the highest artistic excellence. The wood of which it is made is Indian walnut.

The two Drawing-room Chairs which flank the preceding are by Messrs. Poole and Macgillivray, of London; one is carved and gilt, the other carved in walnut-wood, but both are remarkable for originality and elegance of design.

The three handsome Dining-room Chairs below are models of strength and elegance combined, comely and comfortable, as such articles should be; the treatment of the ornamentation is excellent. The legs are handsomely carved, wholly or partially. Wherever else carving is introduced, it is made subsidiary and is nowhere intrusive: take, for example, the wreath which lies over the back of one of the chairs, and the ornament below the back of another. They are all covered with richly decorated morocco leather: they are the production of Mr. Charles Ingledew, also of London.





ENGLISH MODERN MEDIÆVAL WORK.

THE Sideboard, by the famous firm of Crace & Co., of London, will charm the heart of the connoisseur of Elizabethan furniture: it is an admirable reproduction of a remarkable style, of which many examples still exist in the castles and halls of England. The general plan and the ornamentation are perfectly true and good, and the execution throughout as perfect as possible. An ancient dining-hall without some such *dressoir* to show off the family plate on grand occasions is not half furnished.

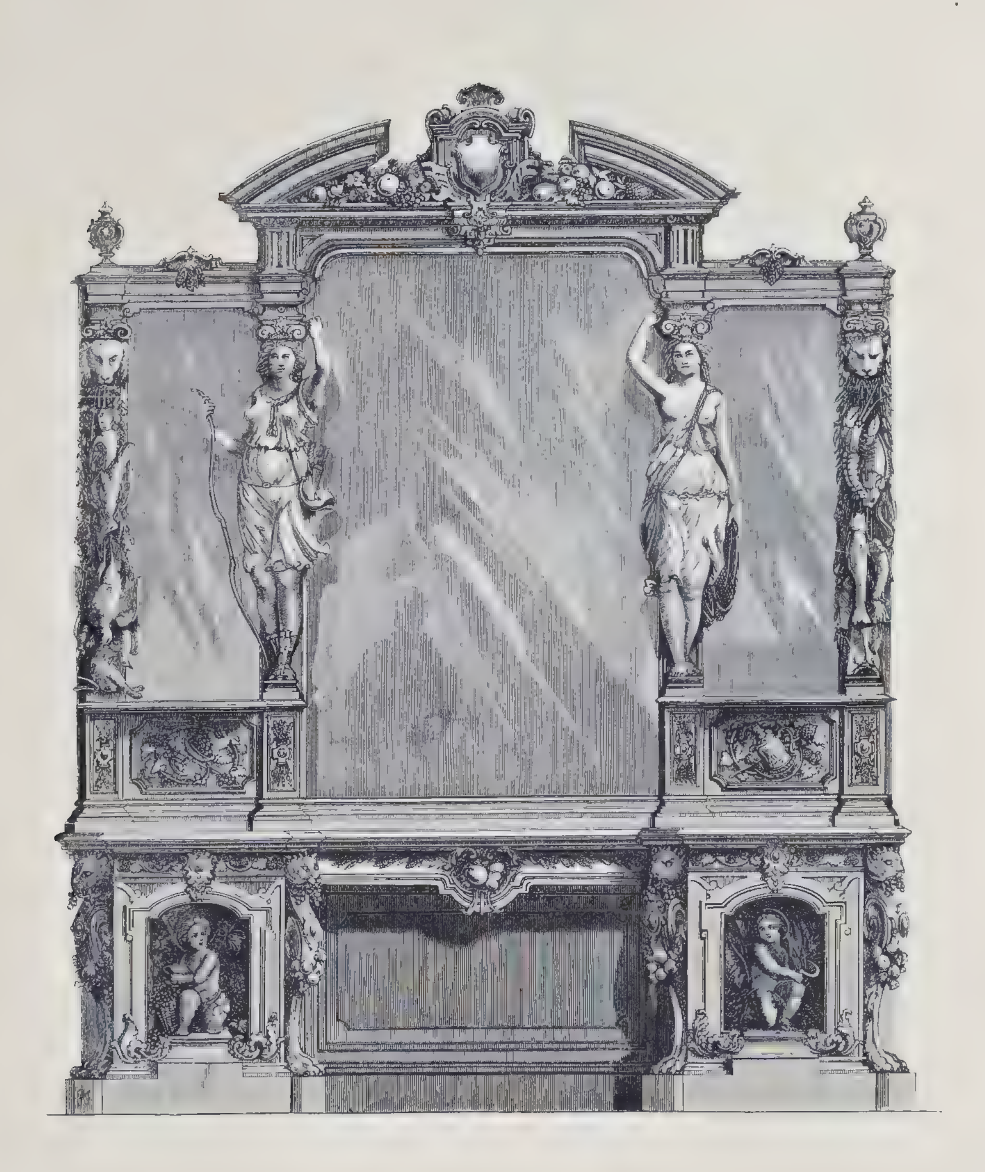
The drawing-room pier-glass, of which the Table is here represented, was executed by Messrs. Fry & Co., of Dublin, for Slane's Castle, in the county of Antrim: it is a work of much taste and even originality, giving an old type in a very charming form. The carving, which is peculiarly bold and effective, is executed in lime-tree wood and richly gilt, but the plinth, for greater durability, is executed in walnut, gilt; the table top is of statuary marble, and above the table is, of course, the glass. The table forms an admirable receptacle for three or five large objects of Art corresponding with it. We here enter on the Exhibition of 1862.



ENGLISH AND AUSTRIAN CLOCK-CASES.

ENGLISH clocks, half a century ago, had fallen into such a state of degradation with regard to their ornaments, that the revival of taste in their cases is peculiarly noticeable. Increased intercourse with France, and the large importation of clocks from that country, no doubt had a great effect; but, at the same time, it must be admitted that there was much imitation which was not remarkable either for accuracy or taste. A better time has now arrived, and we may point with pleasure to the two examples in the middle of this page, by Mr. Edward White, of London, who has not only great taste in design, but skill in execution. Mr. White works in oak as well as in gilt metal.

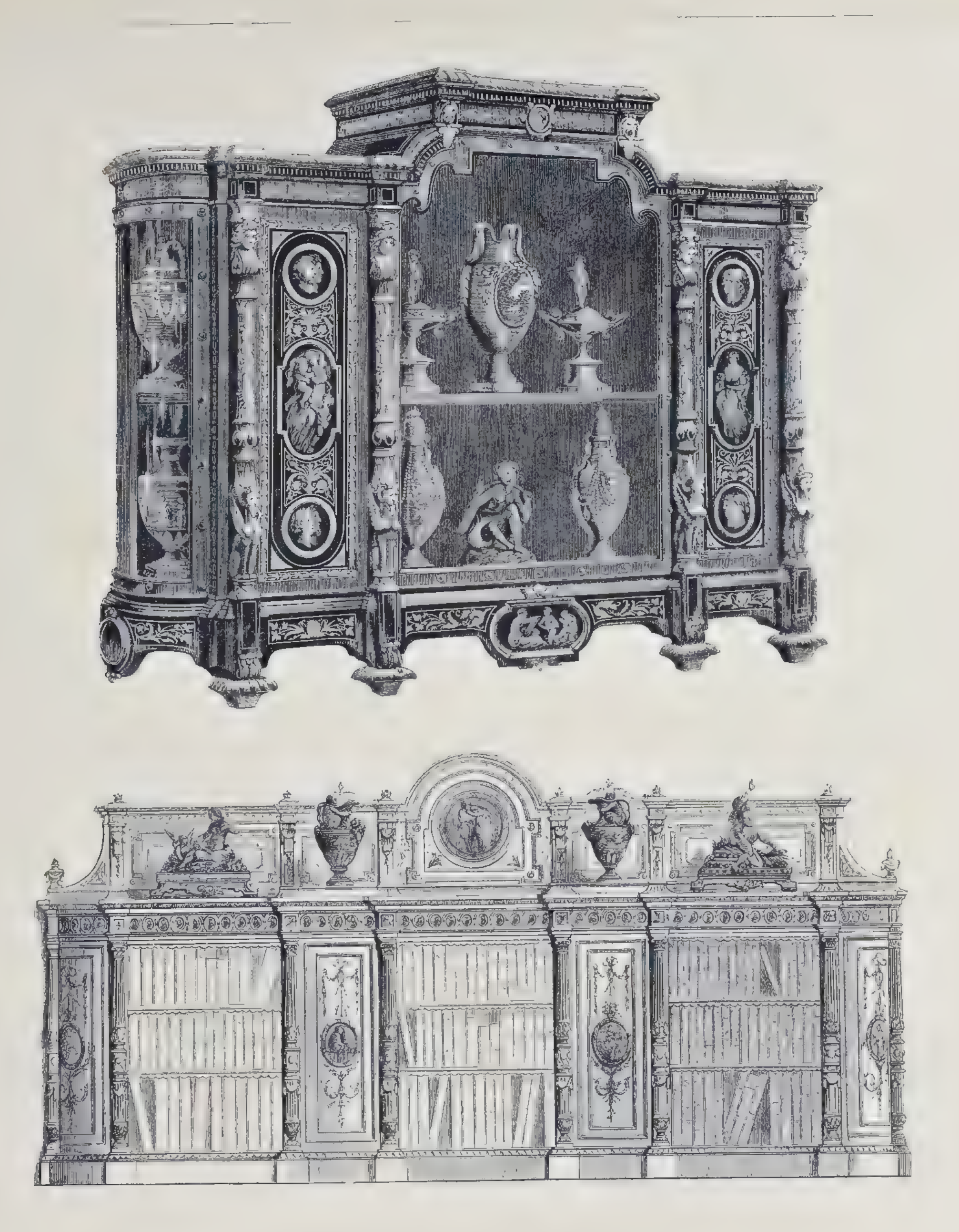
The two pleasing works which occupy the side places are examples of oak cases, by Herr Marenzeller, of Vienna, who exhibited several beautiful examples at the International Exhibition of 1862. The designs are by accomplished artists and very varied, both of which points are well illustrated by the two examples here given. It will be seen that the work is elaborate, but the moderate cost of these beautiful works created an idea, whether well-founded or not we do not know, that machinery had done much for them. This may or may not be; but the work showed no sign of this, and it must not be forgotten that at the time mentioned, if not still, Art-workmanship was not paid for in Austria as in England.



ENGLISH CARVED FURNITURE.

A MAGNIFICENT Sideboard, probably designed for a hunting-lodge, by Messrs. Jackson and Graham, of London. It is in the style of the Renaissance, executed in oak, the carved portions being left dead while the mouldings and framework are highly polished—an extremely effective arrangement. The two emblematical figures, Hunting and Fishing, are boldly designed and executed, and the general ornamentation, especially that of the front below, with the panels and the grim supporters at the angles, is highly successful.

Mr. Lorimer, who is attached to the establishment of Messrs. Jackson and Graham, is the designer of the work. The scale on which this noble piece of work is planned allowed more than usual scope for the design of the carvings, the figures approaching the size of life, and Mr. Lorimer has made excellent use of so fine an opportunity.



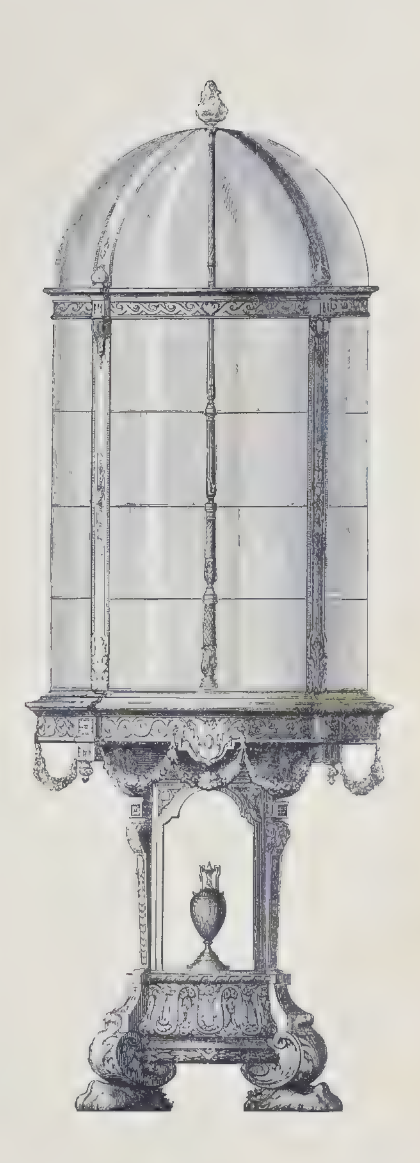
ENGLISH DECORATED WORK.

THE Cabinet shown above is one of Messrs. Gillows' beautiful productions, and presents many novel features: in the first place several kinds of wood are employed, the grounding being in lancewood, with purple wood bands, inlaid with white wood, while the four colonnettes are of boxwood, the general effect being immensely heightened by the introduction of porcelain plaques, by Messrs. Copeland, illustrative of poetry and science. The general design and all the parts exhibit a thorough acquaintance with the Renaissance, and great skill in adapting it. The elevation of the central compartment makes three admirable positions for works of Art of considerable size; and the semicircular glazed ends are very elegant.

The other engraving represents a dwarf Bookcase of a form which is extremely agreeable to the eye, and especially adapted for a large room which is not devoted solely to books, as affording admirable means of exhibiting works of Art in an effective manner. The bookcase is the work of Messrs. Wright and Mansfield, of London. The engraving shows how graceful are the form and principal details of the work—which, however, presents other points to be noted: in the first place the designer has adopted an English style, that of the eighteenth century; next, the wood employed is that known as gum or gean wood, with ebony for the carved colonnettes and mouldings; and, lastly, the whole is heightened by the introduction of plaques of Wedgwood ware in the panels of the doors and in the frieze of the cornice.

It may be mentioned that both these beautiful works are said to have been designed and executed entirely by Englishmen.

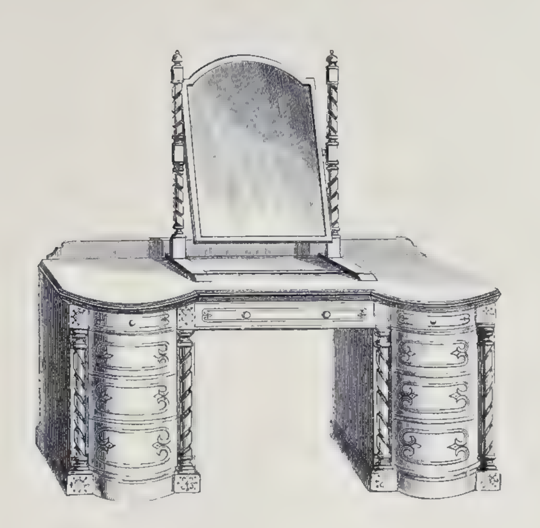


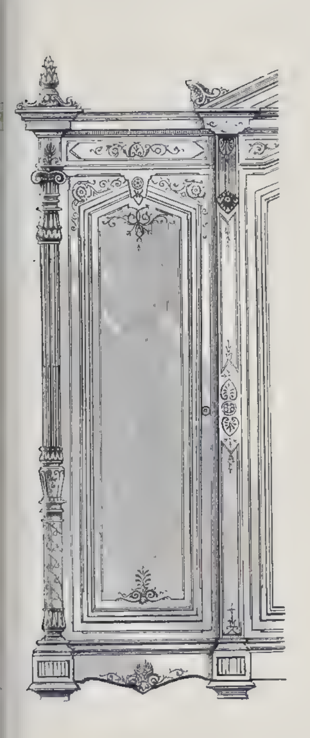


ENGLISH DECORATED FURNITURE.

THE Cabinet here represented is a magnificent example of high art and the highest workmanship; it is on a scale which allowed the artists and the artisans full scope. It is nine feet six inches high and five feet wide, and is one of the *chefs-d'œuvre* of Mr. J. Crace, of London. The designer has selected that which is considered the purest period of Italian Renaissance, from about 1500 to 1530, and the adaptation is highly successful. The work is executed in walnut-wood, which, though so great a favourite in this country, is scarcely considered a decorative wood in France, and never adopted in superior work. Our engraving is on a sufficiently large scale for studying all the main points of the design, and it is almost unnecessary to say that the execution is of the highest class.

The contrast between the two beautiful works here represented is highly effective, each figure sets off the other in an admirable manner. The second work is the production of Messrs. Poole and Macgillivray, also of London, and it presents much novelty; it is a circular glass Cabinet, intended to occupy the centre of a room, or the bay of a large one, and to contain jewels or other precious works of art of a moderate size which require plenty of light to bring out all their beauties; the cabinet revolves upon its stand. The designer has wisely introduced little ornament above, where the gems themselves are to be the objects of attraction, but the lower part is remarkable for elegance as well as fitness, being set back sufficiently to be out of the way of the feet of those around the cabinet, and yet sufficiently massive for stability.



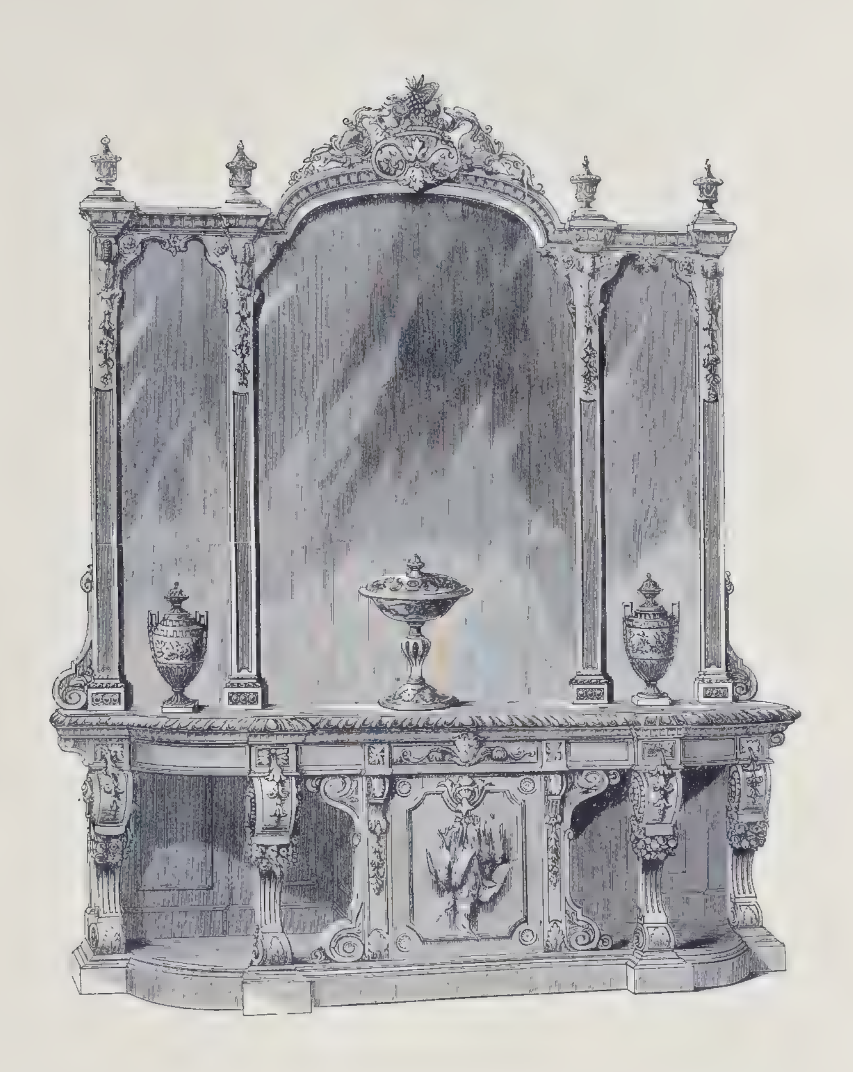




ENGLISH BEDROOM FURNITURE.

THAT great improvement has been made during the last thirty years in English Bedroom Furniture is unquestionable: a heavy, conventional, gloomy fashion, from which Art was almost entirely banished, had invaded all but a few favoured houses; the huge mahogany four-post bedstead and the great flat mahogany wardrobe have given place to bedsteads and wardrobes which, while equally commodious, are infinitely lighter and gayer in effect. The Wardrobe here shown is one of Messrs. Heal and Sons' choice productions, executed in satin-wood inlaid with darker tinted woods, a charming contrast. The portion of a Wardrobe shown by the side of the former belongs to a bedroom suite by the same firm.

The neat little Dressing-table given above is one of Messrs. Dyer and Watts' pieces of polished pine-wood furniture, decorated with colour representing inlay, of which we give other examples.



ENGLISH DECORATED WORK.

A CHARMING piece of furniture in excellent style, pure Italian, but presenting considerable novelty in design, especially in the lower portion, executed in light-coloured oak by Messrs. Clement George and Son, of London; it is stated to have been designed and entirely executed by those belonging to the establishment. It is a pity to see the slightest blemish in such beautiful works of Art as this, but that which we now refer to is common to so many fine works that there is nothing invidious in pointing out here the utter inconsistency of introducing dead game as ornament in connection with the elegant curves of the Italian style. Dead game hanging upside down can never make a fitting ornament; if game must be introduced, surely a pair of pheasants, a grand cock of the woods, or a group of small birds would form a charming picture-panel, and the number of birds and other game is so large, and the vegetation amidst which they may be placed so various, that artists would have an almost endless choice. Painters practise "still life" for colour and texture, but one live bird or rabbit is worth a hundred head of dead game in both respects. Visitors to the late Paris Exhibition had the opportunity of seeing how the Japanese treat living birds and foliage in carved wood: a cock and hen perched upon the top of the gate of their little farm in the Trocadero were perfectly marvellous in execution.



ENGLISH AND FRENCH FRET AND CARVED WORK.

THE first figure represents the lower portion of a Chiffonier by Messrs. Smee and Sons, of London, executed in fine Italian walnut wood, relieved with tulip wood; the two middle panels are filled in with fretwork of elaborate and charming design after the Mauresque, and the other panels are bordered to correspond. The execution of large panels like these in such elaborate fretwork would by the old hand-method have been an exceedingly long and tiresome job, liable to twenty accidents. Messrs. Smee have doubtless availed themselves of the machine fret-saw of which a full description with engraving will be found in our chapter on Wood-working.

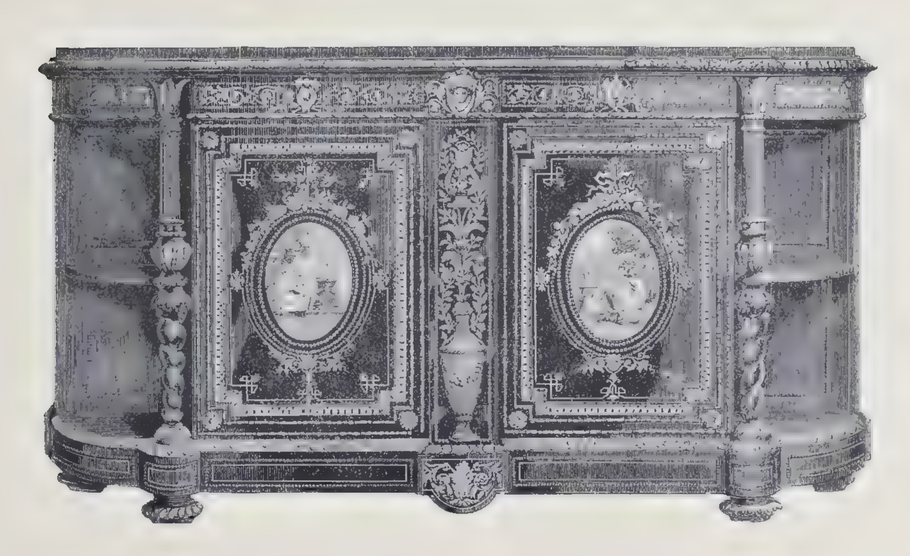
Below are two examples of furniture which may be supposed to be intended for rustic cottages. The first, by Messrs. Guéret Frères, of Paris, eminent carvers, exhibits very bold imitative carving, with an elegant arrangement at top; the other, by M. Tahan, also of Paris, is a piece of florid ornamentation in dark walnut wood, with panels containing coloured copies of Ary Scheffer's famous pictures of Mignon, after Goethe.



ENGLISH SIDEBOARD.

A MAGNIFICENT Sideboard in solid walnut-tree wood, in the style of the Renaissance, produced by Messrs. Gillow, of London, the design being, we are informed, by Mr. Jefferson, who is attached to the establishment, and the whole of the carving executed by English workmen. The form is very fine, well suited to a grand and, particularly, a lofty room. The little pyramidal group above carries the eye up very agreeably; the front is highly effective, and all the mouldings and other decorations exhibit thorough knowledge of style and a sure pencil. The carving is admirable, as we are accustomed to see it in works of this firm. We understand that Messrs. Gillow first established themselves at Lancaster so early as the time of Charles the Second, when many remarkable Art-manufactures were produced, in which, however, the rococo predominated.





ENGLISH CARVED AND INLAID WORK.

ABOVE is an elaborately carved Sideboard, by Mr. Tweedy, of Newcastle. The subjects are derived from the story of Robinson Crusoe.

Below is a very remarkable production by Messrs. Jackson and Graham, of London, a Cabinet of ebony, most elaborately yet delicately inlaid with ivory—another beautiful illustration of the use of the fret-saw. The oval panels, the mouldings, and other ornaments are executed in bronze, chased and brilliantly gilt, and the effect of the whole is truly splendid.



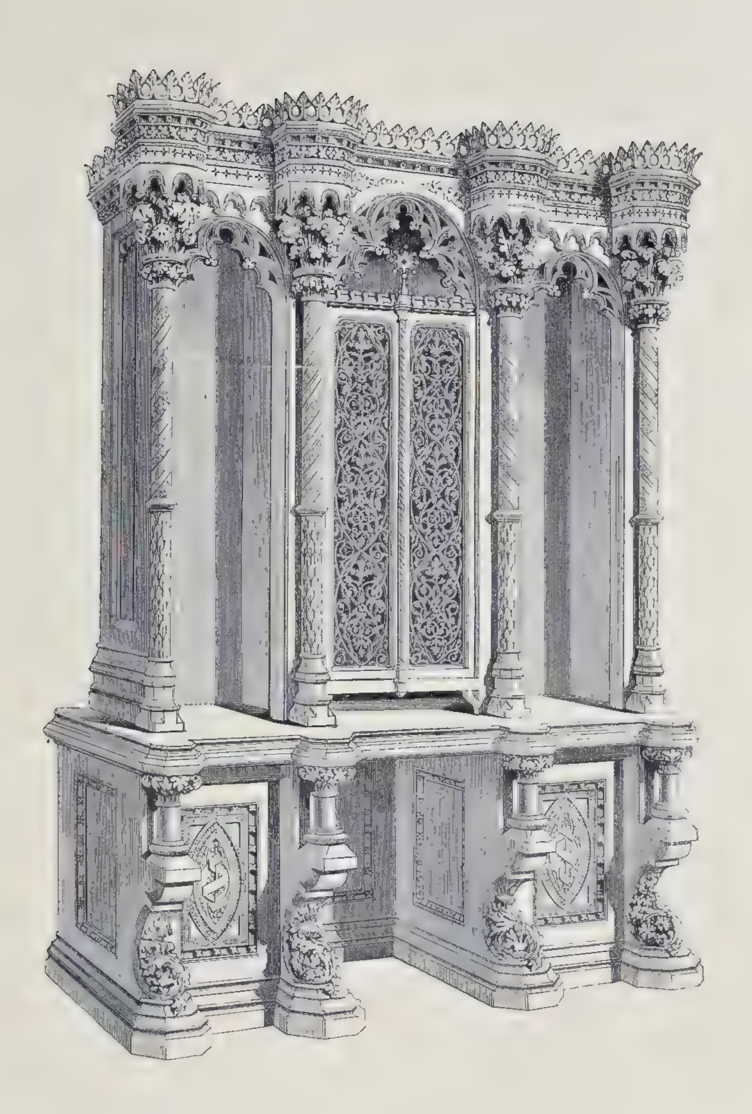
SCOTCH SIDEBOARD.

A HIGHLY decorated piece of work in Italian walnut, by Messrs. John Taylor and Son, of Edinburgh. The figure in the niche represents the old regal sport of falconry, still nominally retained among the pastimes of our sovereigns, the Duke of St. Albans being hereditary Grand Falconer of England, and still, we believe, keeping falcons and hawks. The general effect of the work is very pleasing, the carving in the narrow panels and in the compartments of the semi-circular space above the niche is very effective, and so are the heads on the colonettes, and the trusses to the right and left. The trusses which support the front of the slab with the Bacchanalian masks are bold, and well connected by scroll-work with the slab, and the cresting in pierced and carved work which crowns the whole is a very beautiful finishing feature. The cellaret, or sarcophagus, beneath the sideboard is very fitly decorated with tracery drawn from the leaves and stems of the vine.



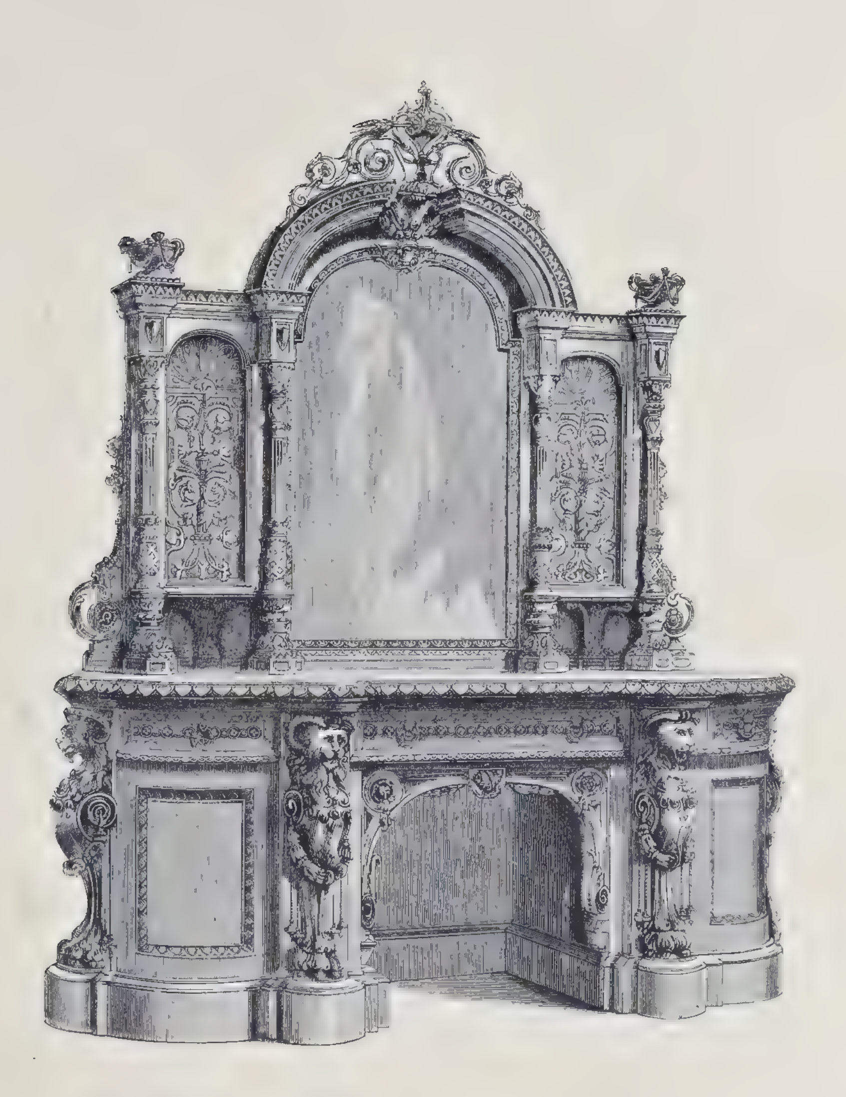
ENGLISH OAK WORK.

A MASSIVE and highly decorated Sideboard, intended for a large dining-room, by Mr. Henry Ogden, of Manchester. It is executed in light-coloured Dantzic oak, inlaid with dark English oak, producing a very pleasing contrast, or rather gradation, of tone. The inlays are well shown in our engraving. The crowning ornament with the arms of the family for whom it was designed, the smaller crests which cap the sides of the ovoid panels below the latter, and the scroll-work on the front of the slab—drawers, we suppose—are all good. The breaking of the line of the slab by the raising of the ends is somewhat uncommon, and when, as in this case, the piece of furniture is on a large scale, might be effectively used for the exhibition of two figures, or for a pair of candelabra.



ENGLISH MODERN MEDIÆVAL WORK.

AN adaptation of the Mediæval style to the purpose of a Bookcase, by Messrs. Hindley and Sons, of London, executed in light-coloured oak, and admirably carved. The slender columns with their florid capitals, the ornamental work over the three compartments, and the trusses below, are designed and executed with great taste. In the engraving, perhaps, the top, which is very elegant, looks rather crowded with ornament; but this is only the result of diminished scale. If a portion of the ornament be drawn to twelve times the size, feet for inches, the leaves, &c., will be found to be bold, and in no way overcrowded. We hope to have the pleasure of giving other examples of the excellent productions of this firm.



ENGLISH CARVED OAK.

AN admirable example of English workmanship by Messrs. C. and W. Trapnell, of Bristol, executed from the design of the senior partner in the firm. It is a thoroughly harmonious work, the form being excellent, the rounded sides giving lightness, and, at the same time, far more decision and character to the whole than it would have possessed had the ends been square, the trusses below and above the slab combining admirably in the effect. The panels, mouldings, in fact the details generally, are designed and executed with much knowledge and skill.



ENGLISH DECORATED WORK.

A SIDEBOARD which attracted much attention at the International Exhibition of 1862: it is the work of Mr. James Lamb, of Manchester, and is composed of pollard oak, walnut, and ebony, relieved judiciously with gold. The two figures which support the glass are life-sized, and represent Vintage and Harvest; they are somewhat heavy in effect. Putting aside our objections to caryatides in any form, especially with prominent elbows, and to masses of dead game and fish, the work must be admitted to be rich in composition and perfect in execution, while the various kinds of wood employed have been selected with much judgment. The design is by Mr. W. J. Estall, and the modelling by M. Hugues Protat. Mr. Lamb had the honour of receiving a gold medal at the Paris Exhibition of 1878.



SCOTCH DECORATED WORK.

THE beautiful Cabinet here engraved formed the principal item in a fine collection of furniture and decorations contributed by Messrs. James and Thomas Scott, of Edinburgh, to the International Exhibition of 1862. It is extremely effective and chaste; the supporting terminal figures are finely modelled, but the chief charms in our eyes are the elegance of the general form of the cabinet and the delicacy of the mouldings and other decorative details; the addition of a plinth for a figure, or a stand for a lamp, to the top of the cabinet was a good idea, as breaking a long line and giving the opportunity of an effective arrangement of *objets d'Art.* The whole is said to be the work of Edinburgh designers and artisans, and it reflects much credit upon them.



ENGLISH POMPEIAN WORK.

ONE of the principal pieces of a beautiful suite of library furniture exhibited by Messrs. Howard and Sons, of London, in 1862, from the designs of Mr. Vandale, artist to the firm. The furniture was executed in black-stained "ebonized" wood, enriched with carving, gilding, and coloured ornamentation. The aim of the artist was to reproduce the style and ornamentation of which so many interesting relics have been recovered from amidst the ruins of Herculaneum and Pompeii, and to adapt them to the requirements of our time. The form is simple and graceful, and the decorative work kept in due subjection. All the ornamentation on the panels and other surfaces is sunk, by which means the gold and colouring are preserved from injury, a method which we have more than once recommended strongly in the cases of articles for ordinary use—piano cases, for instance. Bosses and other ornaments in gilt bronze are introduced here and there. A mechanical arrangement for the convenience of those consulting the works on the shelves of this Bookcase may be mentioned: the four ornamental friezes below form the fronts of desks, which are drawn out by pressure on the adjacent bronze ornaments, and serve to support several volumes.





FLORENTINE AND AUSTRIAN EBONY AND ROSEWOOD WORK.

A MAGNIFICENT example of modern Italian work of the purest style, but, in detail, most elaborate: the design furnishes an admirable study, and the ornamentation is of the best class. The Cabinet is made of ebony, most delicately inlaid and decorated with ormolu, and the effect is rendered rich in the extreme by the judicious introduction of mosaics executed in brilliantly coloured natural stones. This charming work was exhibited in Paris, in 1867, by its producer, Signor Andrea Picchi, of Florence.

The other engraving represents a peculiarly novel and elegant piece of furniture by Herr Leistler, who showed a magnificent collection of beautiful work at the first Great Exhibition; it is a Stand to exhibit miniatures and other small objects of Art, which are fixed on to the two tablets, of which the ends are seen in our side view. The design is as graceful as it is original, and the details are charming in every respect, especially the ornamental top.



PRUSSIAN, FRENCH, AND ENGLISH CARVED FURNITURE.

THE first example here given is an admirable specimen of carving by Messrs. Lövenson, of Berlin, and Jacoby, of London, large producers of carved work. The only possible objection to be made to this beautiful piece of work is that the carving is in danger from careless feet, and is almost too good to be under a table or anything else.

The engraving which occupies the left central place represents a work of great merit produced by Messrs. Mazaroz Ribaillier & Co., of Paris, for Prince Demidoff.

The elegant Sofa Table to the right of the preceding is a specimen of Messrs. Dyer and Watts's stained pine furniture; the design is graceful and unpretending, and the panels between the uprights novel.

The last figure represents a very solid and handsome circular expanding Dining Table, in the beautiful pollard oak so much in vogue in old times with its companion walnut: the design and execution of this table are excellent, and the arrangement of the extension deserves notice. The framework draws out so as to admit quarter, circular, and other leaves to be inserted in the table-top, keeping always the circular form. It is the work of Messrs. Filmer and Son, of London.



FRENCH AND BELGIAN FAUTEUILS, Etc.

THE Fauteuil and Occasional Chair at the head of the page are examples of the chaste treatment given to comparatively unimportant articles by first-rate Art-workmen, Messrs. Fourdrinier, of Paris. The small chair in the middle and the two Fauteuils on the left-hand side are examples of the ordinary manufacture of the firm—or, in other words, of the most artistic furniture of its kind to be seen in the best houses in Paris.

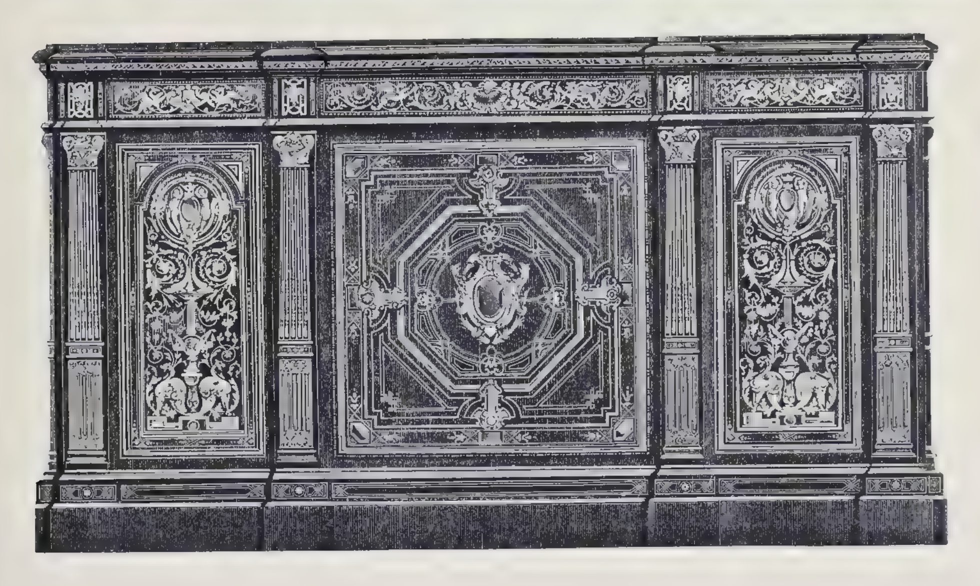
The Grand Fauteuil below is another example of the highest class modern French furniture. It was executed by another famous firm, that of Messrs. Mazaroz Ribaillier & Co., of Paris, for the Comte de Paris.

The two remaining figures represent first-class Belgian work, worthy of the preceding. They are by M. Smyers-Raag, of Brussels—represented in England by Messrs. Bontor and Collins, of London.









ENGLISH INLAID EBONY WORK.

HAVING now arrived at the period which commenced after the International Exhibition held in London in 1862, and terminated with that of Paris in 1867, we select for our first example a very beautiful Cabinet by Messrs. Jackson and Graham. It was with great satisfaction that we saw at that magnificent Exhibition this and some half-a-dozen other fine pieces of English cabinet work which belonged to the first rank of Art manufactures, and would have been quite worthy of any nation or any period. The Cabinet here represented is a charming production of M. Lorimer, with the aid of other artists, in the beautiful Italian Renaissance manner of the sixteenth century. It is composed of ebony inlaid with ivory, and enriched with lapis-lazuli and red jasper. The two engravings immediately above the Cabinet represent together one-half of the ornamentation of the upper portion of the front, and the shorter piece above a side panel of the same portion. The scroll-work and the whole of the ornamentation exhibit great skill and fancy, and the general effect is most pleasing to the eye. It is not often that we see so splendid yet so delicate a piece of work.



FRENCH IMITATION EBONY AND SILVER.

A CABINET of much originality of design and great delicacy of execution by an eminent *ébéniste* of Paris, M. Sauvrezy, who exhibited it in 1867 at Paris: it is executed in pear-tree wood stained or ebonized, and the figures, medallions, and ornaments are of silver, or rather of *bronze silvered.* An exception occurs, however, in the case of the portraits in the two panels of the upper part of the cabinet; these are enamelled, and have an extraordinarily brilliant effect in contrast with the black surface. We cannot admire the broken pediment, which gives the work a false architectural air, and the same may be said of the caryatides; the beautiful carving of our neighbours even cannot reconcile us to the introduction of such architectural monstrosities. In this case, being silvered, they are far too prominent.



ENGLISH MODERN MEDIÆVAL WORK.

THE above illustration represents a *Dressoir;* an example of a piece of furniture the name of which is now known only in the kitchen, but which in times gone by was the principal object in the banquet hall. Its chief use was for the display of ornamental plate and other valuables. On the dressoir, or buffet, were arranged richly "beaten" salvers, vases enriched with gems and enamels, curious hanaps, beakers, and drinking-cups, rare examples of china, majolica, and other ware. One dressoir usually sufficed, but great personages often had three: on one they arranged their silver, on another their silver gilt, and on a third their gold plate and most precious articles.

The example engraved represents a most successful effort to reinstate the dressoir in the dining-room; to re-introduce the use of native woods—oak instead of imported mahogany, rose, and other woods, from which in modern days English furniture is principally made. It is produced by the firm of Holland and Son, of London, from the designs of B. J. Talbert, and is true to the principle of attending first to construction and afterwards to appropriate decoration: in feeling it is thoroughly English, as its construction is perfectly adapted to the nature of the wood employed. The carving is executed in complete accordance therewith. In portions there are delicate leafage, but protected by mouldings which overhang; the panels of the cupboard doors are decorated by incised carving, such as conventional flowers, and the hinges on which these doors are hung, it will be observed, are on the surface of the doors, and serve to enrich the general effect. Other parts are enriched by insertions of inlays of ornamental woods, as ebony and boxwood. The horizontal framework or fronts of the shelves bear mottoes which tell of the use of the dressoir and of the apartment wherein it is placed. Colour is also introduced, which increases the general effect. The artist, it will be observed, has introduced a pictorial subject in the sunk panel above, and additional richness is given by the narrow embroidered hangings in front of the upper shelf.



SWISS CARVED WORK.

THE rustic carvings of Switzerland have long been famous: the poor goatherds during their leisure moments in the mountains have been accustomed for ages to carve all kinds of small useful and ornamental objects in wood, combining it frequently with the chamois horn. One form of these carvings is that of animals, cows, goats, kids, &c., so small that the legs are scarcely thicker than ordinary thread, yet they show an admirable eye for form and expression. Messrs. Wirth, of Brienz, have done much to cultivate this wonderful talent of their countrymen, and have produced carving of great excellence, which, being included in artistic designs, has given rise to the production of some of the most charming pieces of decorative furniture of the day. The Buffet, or Cabinet, here represented, which was exhibited in Paris in 1867, is one of the most elegant of their works; it is full of artistic grace, and the carved ornamentation is beautifully delicate. Messrs. Wirth have establishments both in Paris and London; other works by them will be found amongst our illustrations.



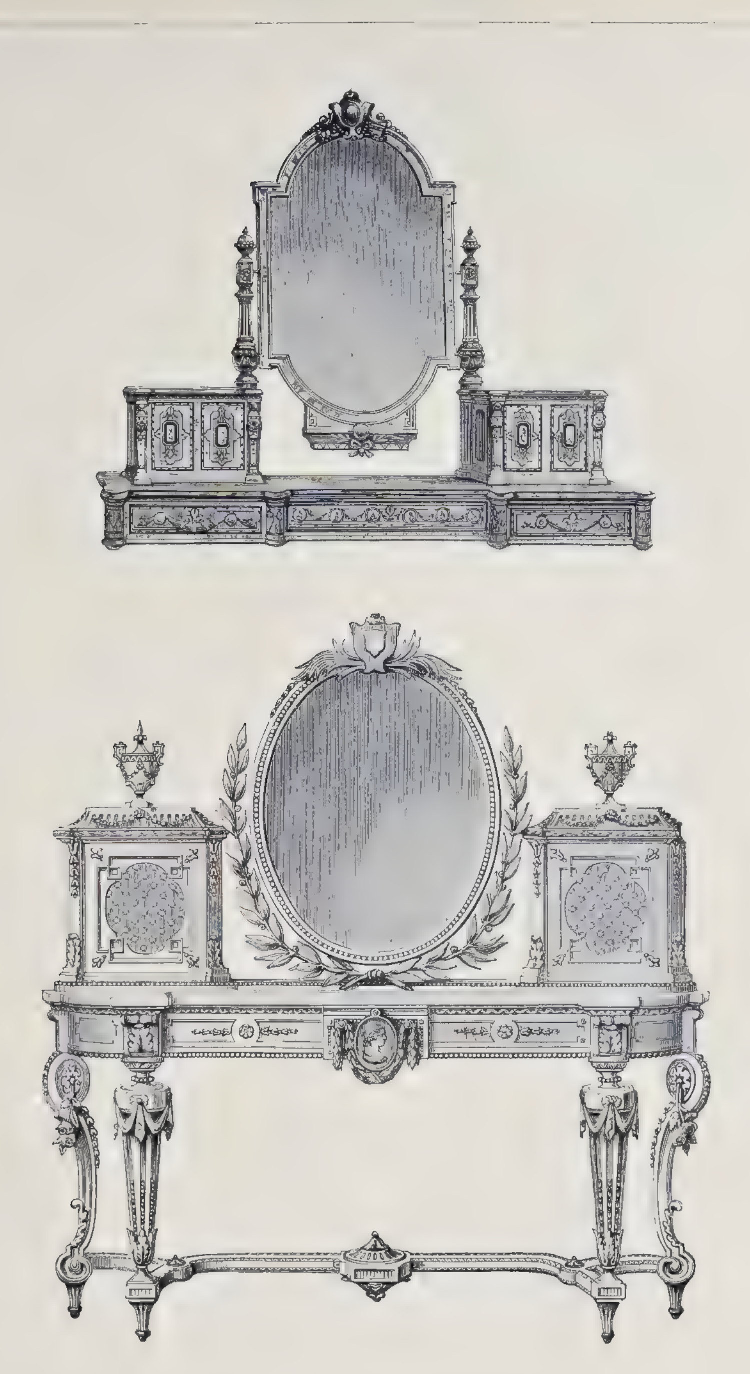
LONDON CARVED WORK.

A GRAND example of furniture of the highest class, shown in 1867. As a piece of architectural construction it possesses high claim to attention, but it must be objected that the triglyphs and guttæ of the Greek façade, which are considered to represent rain, are out of place in a sumptuous object like this, never intended to be exposed to the elements. But the beauties of this palatial Sideboard or Buffet are striking: the position of the two figures of boys, raised as it were on pedestals, and serving as supporters to the grand glass frame, is very happy, and all the details, from the admirably designed solid pillars in front to the beautiful free masses of decorative sculpture at the ends, the charming filling in of the pediment, and the delicate tracery on the pilasters, are all exquisite examples of artistic design. This beautiful work is the production of Messrs. Trollope and Sons, who have produced innumerable fine examples of decorated furniture, but few, if any, superior to this.



MODERN ARABIC WORK.

AN example of that which is very rare, namely, a fine modern adaptation of the true Arabic style: it is composed of various coloured woods, in parts inlaid, and forms part of the embellishment of the kiosk of the Khedive in the Park at Cairo. The design and ornamentation are well shown in the engraving; on some of the panels are Arabic inscriptions in relief; these are the composition of Mustafa Salam, a distinguished poet of Cairo, the tenor of which is that:—"Under the beneficent reign of Ismael, Art and Industry extend their wings that they may return to Egypt in their ancient splendour and glory." The designer and executor of this beautiful work is Giuseppe Parvis, an Italian by birth, who for some time filled the post of furnisher to the late ruler of modern Egypt, and the student may safely accept the work as a truthful reflection of the Arabic.



LONDON DECORATED WORK.

THE upper portion of a Toilet-table represented above is by the well-known firm, Messrs. Hunter, of London, of whose productions we have given more important though not more graceful examples.

The larger figure is the production of another large and well-known firm, Messrs. Heal and Son, and was one of many charming examples shown by them at the Exhibition of 1862. It is executed in mahogany — well-selected, straight-grained mahogany being one of the best known woods for such a purpose—carved and enamelled in pure pearl white, and the wreath, the tracery, the mouldings, and portions of the ornamentation are beautifully gilded. It is but rarely that we see the Louis Seize style more admirably adapted in this country. The design was by an artist attached to the establishment.



GERMAN OAK WORK.

A HANDSOME Sideboard, with shelves for the exhibition of plate or porcelain, treated—with the exception of the pediment, which is a piece of stone structure—precisely in the manner that oak should be treated. The lower portion strikes us as peculiarly happy in conception; the panels, designed with great skill and taste, contrast most admirably with each other; that in the centre is remarkably novel and appropriate; the designs of the two long panels between the pilasters are excellent, and the two groups above are designed in a masterly manner. This is one of many remarkable works by Herr Bembe, of Mayence. It was exhibited in Paris in 1867.



ENGLISH EBONY WORK.

ANOTHER of the gems of English Art-workmanship shown in the great Paris Exhibition of 1867. It is the production of a firm which has accustomed us to surprises—Messrs. Gillow, of London—and it is fully worthy of their long-established reputation. The artist (we are sorry not to be able to record his name) is evidently an accomplished student of Italian Art; but he has been most happy in the present instance in giving originality to his general design, as well as to the arrangement of the details. The niches on each side of the doors are peculiarly elegant, with their clusters of colonnettes, their brackets, and their crowning decorations; they are intended to receive statuettes. The vases—which, however, look extremely graceful in their temporary places—do not belong to the design, nor does the beautiful covered *coupe* which stands on the slab. The latter is a charming example of Parisian bronze-work, and will be found in that division of our work which deals with Metal-work; the position seems specially designed for a beautiful work of Art. The effect of the whole is charming, relieved by plaques of Limoges enamel.



ENGLISH AND SWEDISH CARVING AND GILDING.

FOUR elegant examples of ornamentation.

The first is a charming gilt Cornice by Messrs. Nosotti, of London, who have contributed many beautiful works to our Exhibitions.

The second is the top of a Cabinet by Messrs. Brunswick, of London, who have been very successful in introducing buhl and other inlaid work into this country, and of whose productions we hope to give other examples.

The other two figures represent the principal carved portions of an admirably designed and executed Bedstead in oak, shown at the Paris Exhibition of 1867. This work was executed by Mr. Edberg, of Stockholm, from a design by an eminent architect of that city, Mr. E. Jacobson. This bedstead is an elaborate piece of work, but delicate in all its details: the portion represented in the upper of the two figures is remarkably effective, and shows a master-hand.



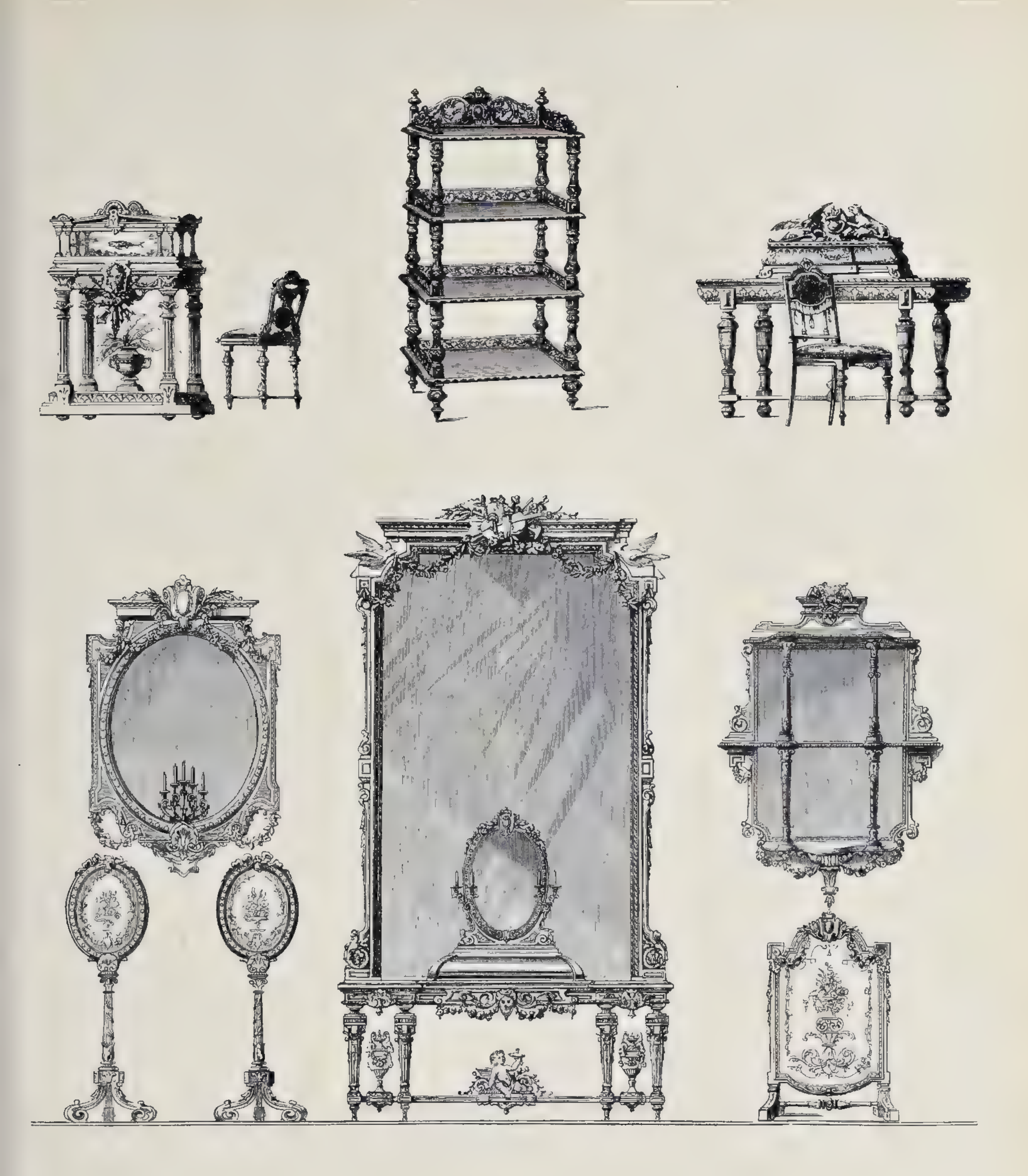


PARIS EBONY WORK.

TWO beautiful examples of the art of Paris *ébénisterie* of the first class, both executed in ebony. That towards the left hand is the work of M. Roll, and is especially remarkable for studied neatness of design and delicacy in the details: the superadded ornaments are in bronze gilt.

The other figure represents a sumptuous Cabinet, executed for Prince Demidoff by Messrs. Mazaroz-Ribaillier & Co. Here we have an example of much boldness, and the details are superbly carried out.

Works of this high character are set off by being brought into comparison with their equals in a different style. The delicacy of one relieves the boldness of the other in representation; they would have an incongruous effect in actual presence of each other.



BERLIN, LONDON, AND SWISS CARVED WORK.

THE Whatnot or *Etagère* above is a good example of the admirable carved work of Messrs. Lövenson (of Berlin) and Jacoby (of London), of which we give other and more important specimens.

The two charming *Secrétaires* which flank the *Etagère* are the work of another firm—that of Messrs. Wirth, of Brienz, in Switzerland, and London, equally famous both for large production and artistic execution. These elegant productions were exhibited in Paris in 1867.

Well worthy of association with the admirable works above-mentioned is the beautiful group of gilt furniture which occupies the lower part of the page, and which formed a part of the contributions of Mr. Harcourt, of London, to the International Exhibition of 1862. The designs are extremely delicate, while there is considerable originality in some of the forms; admirably executed and splendidly gilt, their effect was brilliant.

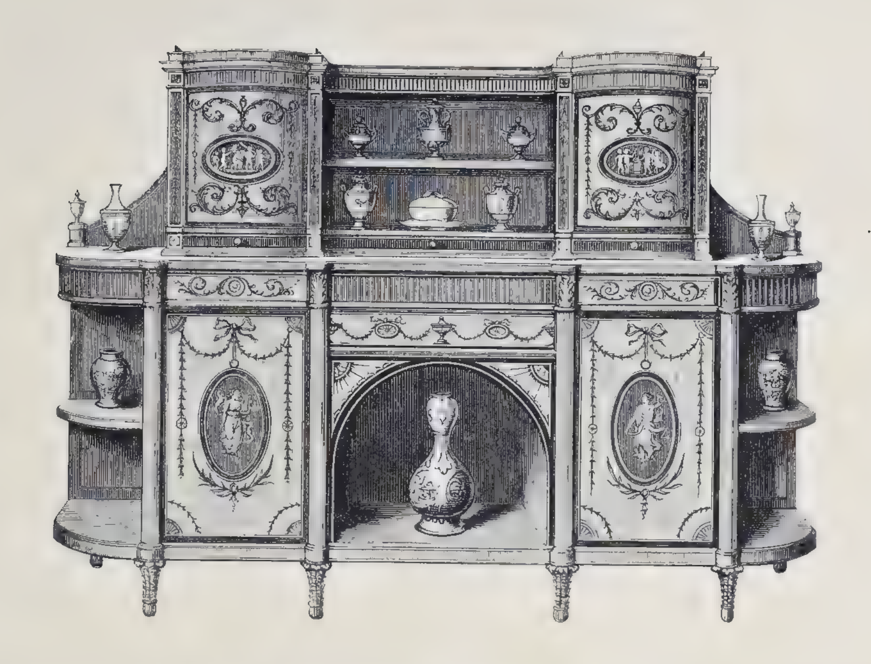




FRENCH AND ENGLISH CABINETS.

THE larger of these two Cabinets is a very successful reproduction of the style which was in great vogue both in France and England a century since; but which had fallen almost entirely out of use until lately. The present is an extremely chaste example by M. Tahan, of Paris. The new cabinets of this kind have a decided superiority over their old congeners in one respect—namely, the beauty of the delicately-veined woods of which they are composed. The *ébénistes* have a much larger supply of beautiful veneers now than they had formerly, and are not obliged to have recourse to dyed varieties, which present sad faded blots in many of the old cabinets.

The other figure is that of a beautiful fancy Cabinet formed of ebony inlaid with ivory and decorated with various precious stones, selected and set with much taste and skill. It was exhibited in 1862 by Messrs. Litchfield and Radclyffe, of London. The bowl forms a good feature in the general design, and is meant, we presume, for a pot-pourri.





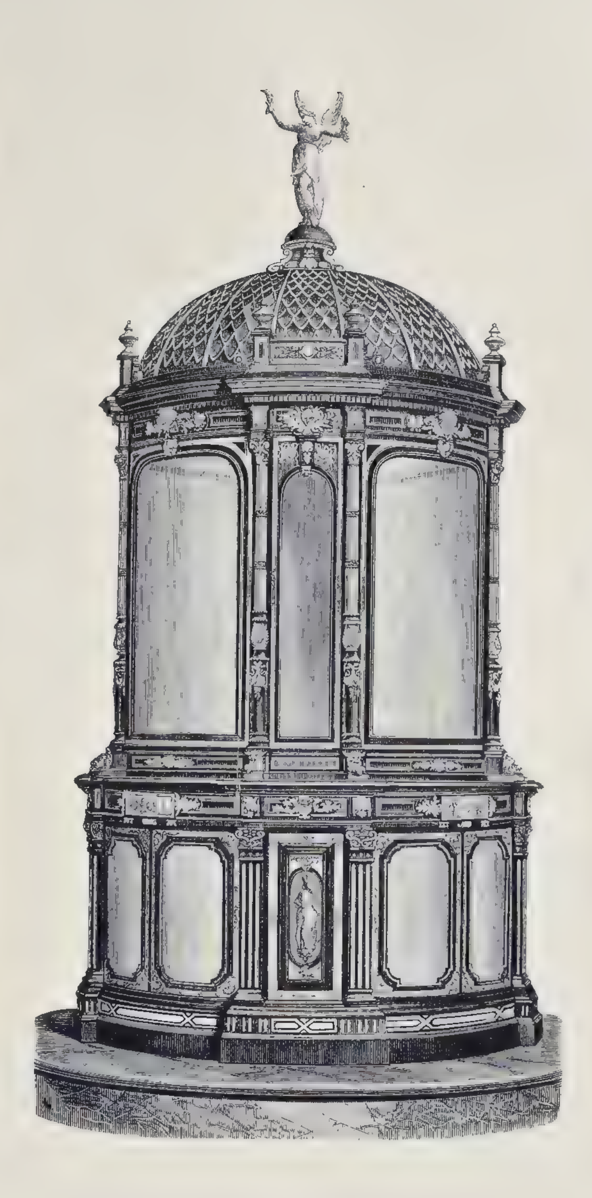
ENGLISH AND FRENCH WORK.

ABOVE is a remarkably delicate example of the work of Messrs. Wright and Mansfield, of London; a most elegant piece of furniture for a small drawing-room or boudoir, very pure and graceful in design and execution.

The magnificent Table below is an example of no ordinary type: the elements are in the main Egyptian, and are dealt with in the true spirit of ancient Art; but there is so much originality in the conception of the design and the application of details that it becomes an original and a grand work. The vigour with which the whole of the ornamentation is drawn and executed is delightful. It is the work of M. Diehl, an eminent *ébéniste* of Paris, from whose beautiful contributions we have selected other examples.











FRENCH EBONY AND IVORY WORK.

A SUPERB example of a grand piece of furniture of which one or two more only will be found amongst our illustrations, namely, a Cabinet to contain the rarest gems and to occupy the centre or a grand bay in a splendid salon. The cabinet is the work of MM. Alessandre et Fils, of Paris, and it is executed in ebony profusely enriched with carvings in ivory. It is a most thoroughly successful and beautiful work in all respects, but especially as regards the ivory work, which is of a class to which we have been almost strangers of late years: the winged genius which crowns the work, the four admirable statuettes representing the Arts and Sciences that occupy four niches below, and are represented separately in our illustrations, and a number of smaller figures in bas-relief, are the work of an artist of high order, such as are only to be found in collections of the highest class and which belong principally to the Italian Renaissance. It is a charming *renaissance*, this, of true Art-work in ivory.



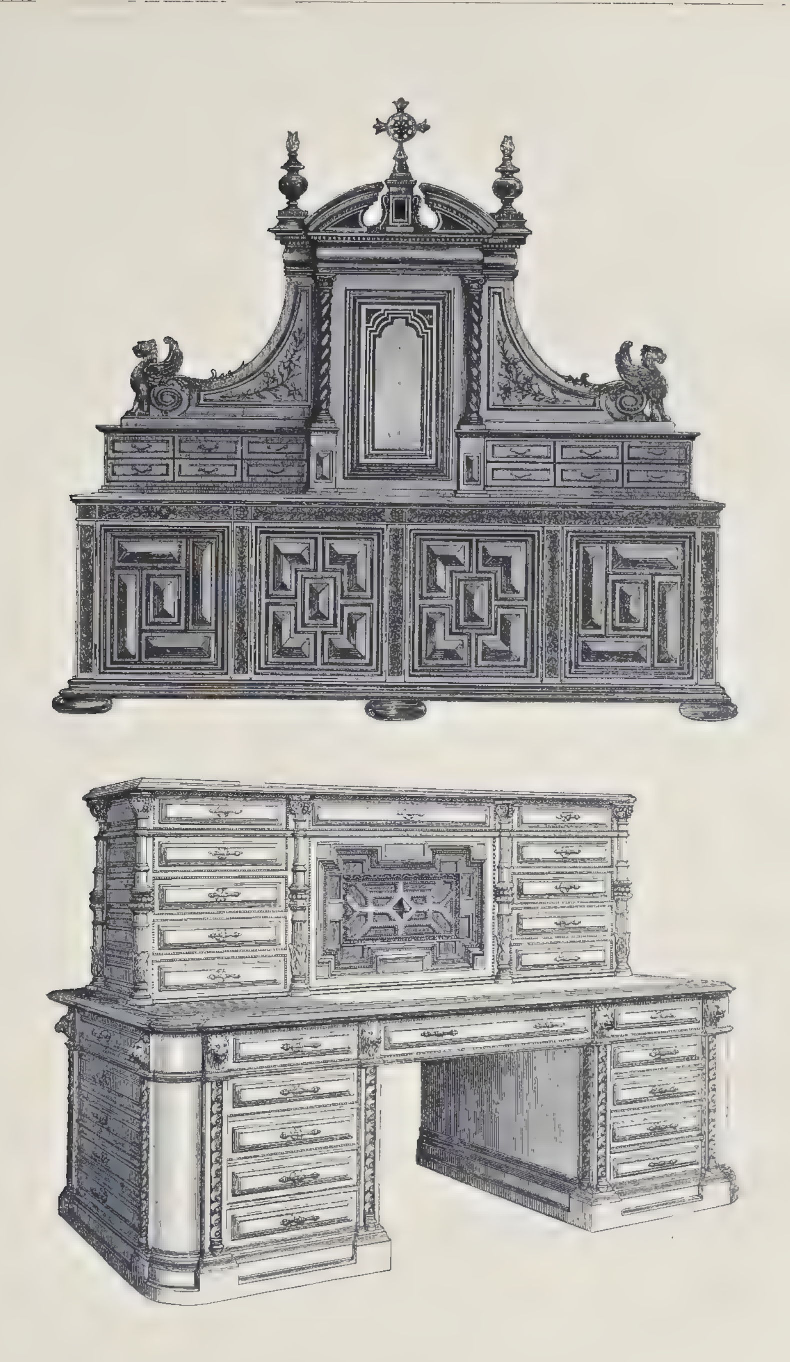
BELGIAN EBONY CABINET.

CABINETS have so long been favourite articles of furniture, and so much ingenuity has been displayed in their construction, that it would seem almost impossible to produce any new form or arrangement for such a piece of Art-furniture; but nothing is impossible to the true artist, and such is the producer of the Cabinet before us, M. E. Gobart, of Ghent, one of the first *ébénistes* of Belgium. The work is in ebony inlaid with other fine woods, and decorated with carving; the general form and details are extremely elegant, and the disposition of the parts has probably been specially arranged for a certain class of *objets d'art* not of large size. M. Gobart's work is executed in the best manner, both as regards construction and decoration.



MILAN EBONY AND IVORY WORK.

ITALY has produced a vast number of the most exquisite artistic objects in the world, but few, if any, superior, in its class, to this beautiful Cabinet before us; artists and Art-workmen have laudably striven together, and the result is eminently successful; not only the general design but every detail is worked out in the most artistic and perfect manner, from the beautiful figures to the minutest ornament. It is formed of ebony exquisitely inlaid with ivory. The general design was furnished by Signor Luigi Annoni, the engraving of the ivory executed by Signor Giovanni Brambilla, and the work produced by the house of De Amici Angelo, of Milan.



GERMAN AND ENGLISH OAK WORK.

TWO pieces of furniture conceived in the same spirit, although differing from each other totally in style and design, forming worthy companions to each other.

The Cabinet above is the work of Herr Bernard Höen, one of the leading *ébénistes* of Germany: it is very simple, graceful, and effective, and presents considerable novelty in form.

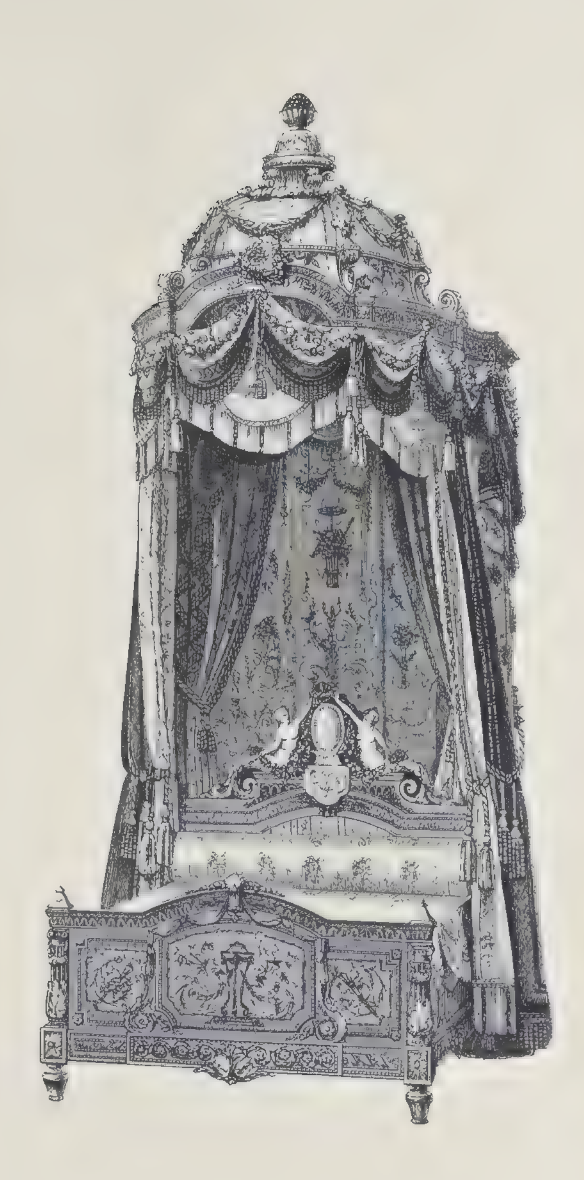
The second illustration is that of a Cabinet and Writing-table combined, by Mr. Thomas Knight, of Bath: this is of oak, relieved with ebony. The design is simple but good, and the desk-flap is treated very artistically; when closed up, as shown here, it forms a beautiful panel decorated with malachite, lapis lazuli, cornelian, and serpentine, and when open makes a commodious desk and presents a large assortment of writing materials.



PARISIAN EBONY AND ORMOLU.

A VERY remarkable work, decorated in a style which our neighbours have made their own: the Cabinet is formed of ebony, and the ornamentation is in gilt and matted bronze, finished with the greatest nicety, and contrasting most favourably with the heavy ormolu of the old rococo work, which, however, had, and still has, admirers; nothing could well be more simple than the general outline of the cabinet, or more elaborate than the ornamentation, which belongs to a high order of Art. The producer of this beautiful work is M. Beurdeley, of Paris, who has here achieved great success.

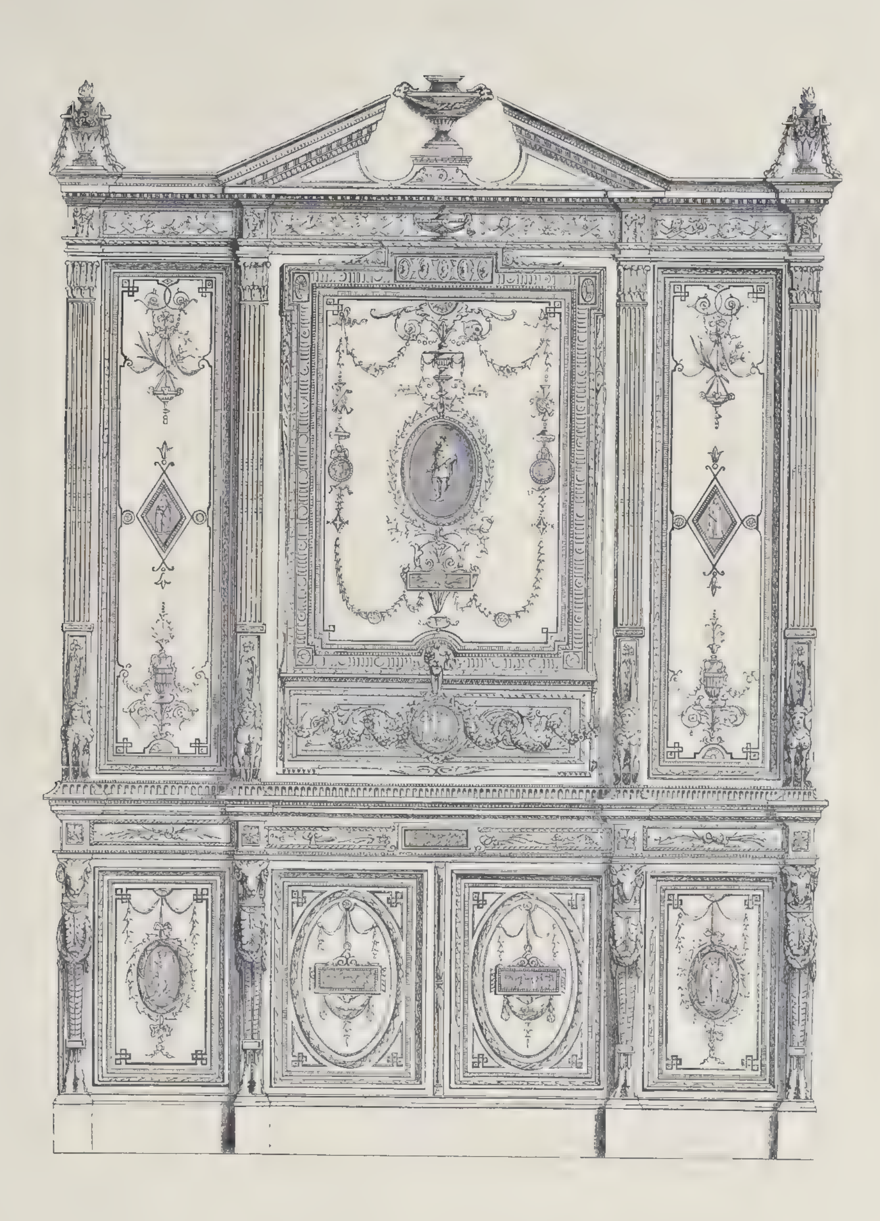




FRENCH AND ENGLISH BEDSTEADS.

THE beautiful Bedstead on the right hand is one of the charming productions of M. Fourdinois, of Paris, and is as full of grace and beauty as any of the works emanating from that famous Art-workshop; the top is remarkable at once for novelty, boldness, and elegance; the foot-board is most gracefully designed, and the carved escutcheon and supporting figures, raised well over the head-board out of the way of the occupants of the bed, are very effective. Shown, as this bed was at the 1867 Exhibition, perfect as seen here, the hangings of the most exquisite materials and the tones deliciously harmonized throughout, it was a triumph of true Art-industry.

The other engraving represents a portion of an elegant Bedstead by the well-known firm of Messrs. W. and J. R. Hunter, of London, whose productions have furnished us with several other admirable illustrations of English artistic work.



ENGLISH INLAID SATINWOOD.

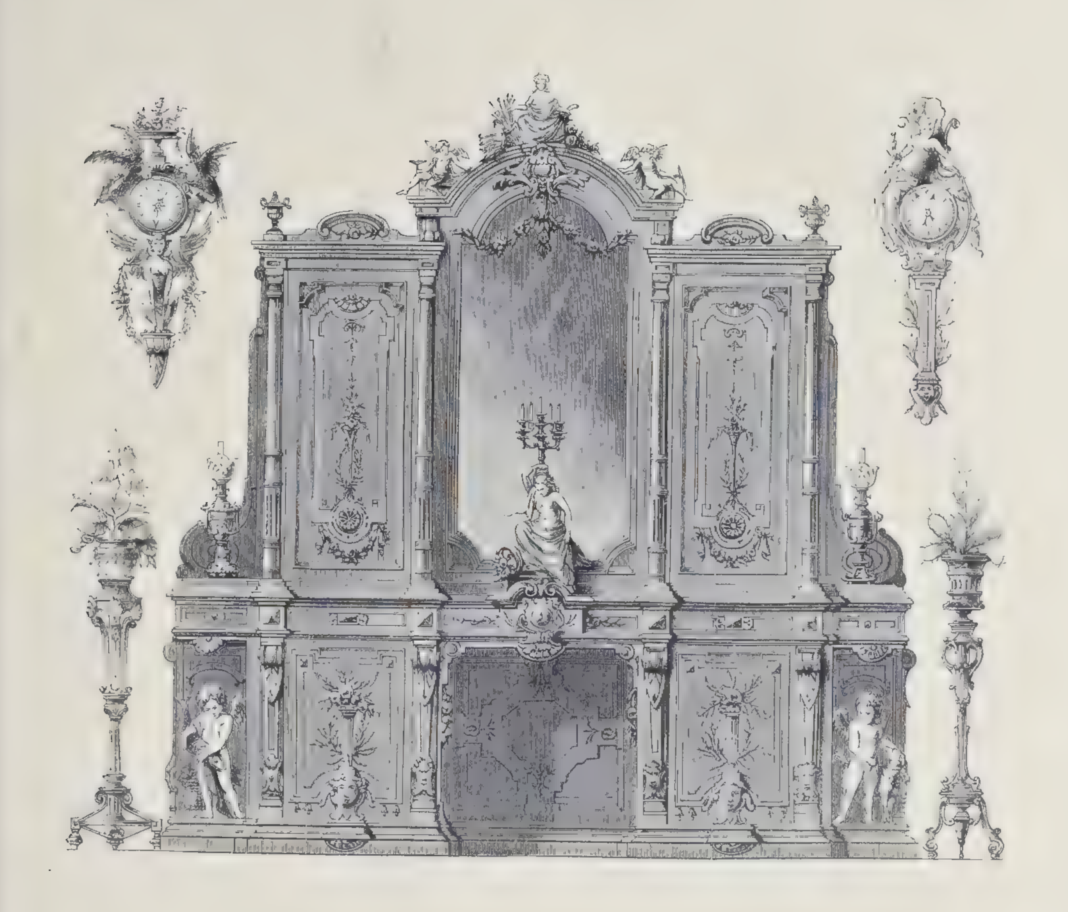
A SUPERB example of Art-workmanship in wood by Messrs. Wright and Mansfield, of London, which received the highest honours at the Paris Exhibition in 1867, and was then purchased for the South Kensington Museum, where it can be examined in all its details; but for the benefit of those who have not the opportunity of visiting London, we should say that the Cabinet, which is of large size, is of satinwood, exquisitely inlaid with choice marquetry of all colours, the whole being enriched with plaques of Wedgwood ware, which occupy the centres of all the panels. Altogether it is one of those *chefs d'œuvre* which are only produced at long intervals. It was designed by Mr. Crosse, and is stated to have been executed entirely by British artisans.





GERMAN DECORATIVE ART.

A REMARKABLY graceful Sideboard or Cabinet by Herr Gustav Stovesandt, of Carlsruhe, one of the principal manufacturers of decorative furniture in Baden, with a world-wide reputation. The work before us needs little said about it, the graceful form at the lower portion and the two beautiful figures which support the glass speak for themselves; in the hand of the male figure is some dead game, and the female carries grapes the one indicative of sport, the other of fruitfulness. The artist of this charming cabinet has had better taste than to load his panels or any other portion of his work with masses of dead creatures or even of fruit; on the contrary, each panel is brightened by carvings representing children engaged in husbandry, game or other creatures, in all the beauty of life and motion. The work is executed in three kinds of walnut-tree wood—the body in German, the raised ornaments in Italian, and the carved bas-reliefs in American.



SWISS CARVED WORK.

A COLLECTION of examples of the productions of Messrs. Wirth Brothers, of Brienz, in Switzerland, and also of London and Paris, who are famous for furniture and other carved articles of various kinds, from the simplest to the most elaborate in design, which they produce in great variety. The Swiss peasants have long been famous for rough carving, exhibiting remarkable aptitude and a really artistic eye for form—the minute carvings in white wood of cows, goats, chamois, and other animals, are amongst the greatest curiosities of the shops—and Messrs. Wirth have encouraged and systematized this talent with excellent results. The examples here represented require no explanation, and other specimens will be found amongst our illustrations.





ENGLISH DECORATIVE WORK.

A CHARMING production by Messrs. Gillows, of London, a combination of the Console and Glass with the Cabinet and Étagère, formed of several kinds of ornamental woods, the principal carved ornaments being in box, while the elegant designs in the panels, illustrative of Painting and Architecture, are inlaid in various coloured woods. The whole is designed and executed with the utmost delicacy, and in part proof of this we append a sketch of the charming ornamentation, drawn on a much larger scale than the cabinet itself, which decorates the panels on the sides. The Italian style has here been adapted with great taste.



PARISIAN ART WORK.

A PRODUCTION of striking beauty and perhaps one of the most perfect specimens, in its own style, ever produced: it is the work of MM. Christofle, and every portion exhibits the artistic taste and skill of our neighbours as exhibited in such works; every iota of this charming production has evidently been studied with the utmost care. The figures are sculpture, not ornaments; the Cupid surmounting the globe is delicious, though we should rather have seen him in a higher position. We must add, too, that the cross-bar is overloaded with ornament. The figures were modelled by M. Carrier-Belleuse, whose works are well known in this country, and the ornaments are from designs by M. Joseph Chèrer, whose reputation is deservedly high.



ENGLISH DECORATIVE WORK.

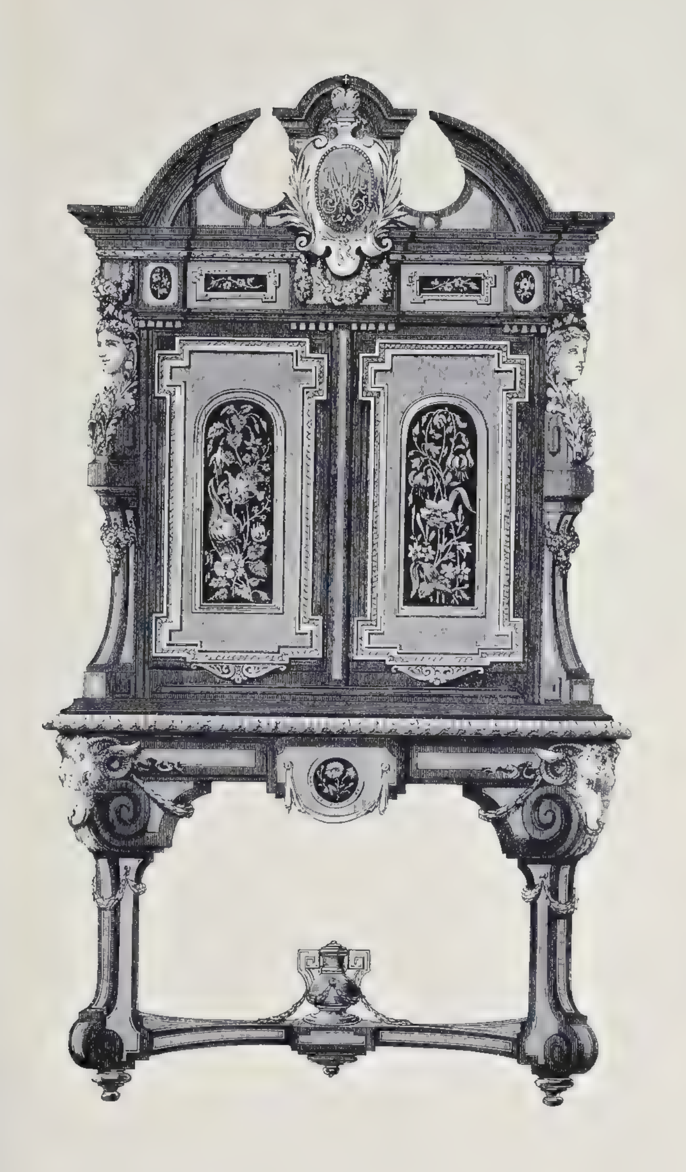
A CABINET of admirable design and proportions and first-rate workmanship, executed in various coloured woods and decorated with beautiful medallions in Wedgwood ware, by Mr. Lamb, of Manchester. It is a very rare occurrence in any country to find such beautifully artistic furniture produced in any but the capital, and it is most pleasing to find that Great Britain is remarkable in this respect: this is not the only example of Mr. Lamb's work to be found in our illustrations, which also include works from Warwick, Taunton, Bristol, Newcastle-upon-Tyne, and other provincial cities and towns. Mr. Lamb won high honours the other day in Paris.

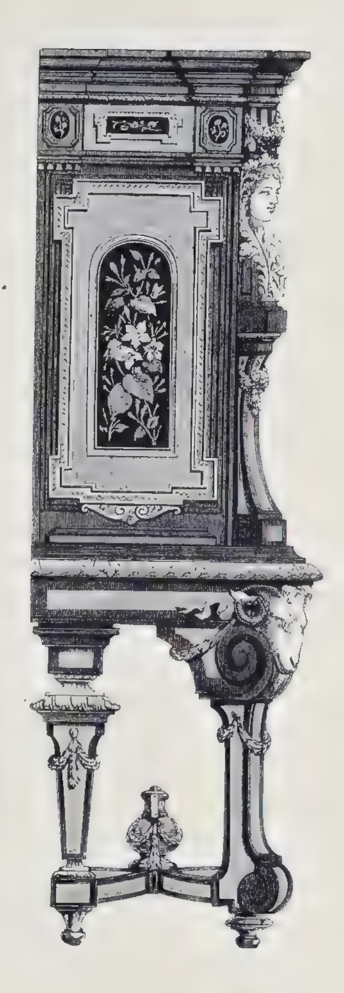
It is well to add that the application of Ceramic plaques requires much judgment to produce complete harmony.



MODERN ITALIAN CABINET.

THE debt which all the world owes to Italy for bringing back to us classic art and fitting it to all the requirements of comparatively modern society, in the form of furniture, jewellery, metal work, *objets d'art* and *bijoux* of all kinds, is never likely to be repaid; the Renaissance travelled abroad and took root there, in France especially, and has flourished marvellously, but Italy did not lose her own cunning and has not lost it yet; it would be difficult to find anywhere a more beautiful example of ornamentation than that before us, by Signor Gatti, of Rome; it is executed in ebony inlaid with ivory. Each portion is not only beautiful in itself but peculiarly fitted to its position, revealing the true artistic hand: we find no ornament represented upside down, making uniformity out of mere inversion; the scrolls which fill the vertical panels and the upright borders all spring from well-marked foundations, and, as it were, grow upwards, while in the horizontal panels the ornaments are very properly repeated, but not in such a manner as to place any flower or ornament in a false position.





RUSSIAN DECORATED WORK.

A TRULY Imperial Cabinet belonging to the Empress of Russia: the general design is peculiar, and certainly will not please every one—the broken pediment is a great mistake—and the characteristic beauty of the work cannot be shown in printers' ink; it resides in the flowers which form the decorations of the four great panels, two in front and one on each side, of those of the frieze, and the medallion below. These flowers are charmingly drawn and grouped, and are executed in precious stones of the choicest kind—jasper, cornelian, &c., the term precious stones being now understood to include all ornamental stones with the exception of the gems such as ruby, garnet, and amethyst—selected, matched and set with the greatest taste and skill.



DANISH CABINET.

CABINET decorated with inlaid woodwork in the style of the period of Christian IV., a style with which we have little acquaintance in this country, designed by Professor Heine Hansen, the inlaid work by Mr. C. Ronne. One leaf of the door is omitted to show the arrangement of the interior. This Cabinet is only one of many meritorious productions produced by a society in Copenhagen in the year 1860, for the express purpose of encouraging the "Union of the Fine Arts and the Arts of Industry." There is little doubt that this society is one of the results of the series of international exhibitions which commenced with our own in Hyde Park in 1851, and to which no one is perhaps so deeply indebted as the Art-workmen of our own country. The general form of the Cabinet is simple and good, the top mouldings very bold and effective; the curved rail below is out of keeping and quite unnecessary.



ENGLISH PAINTED FURNITURE.

PAINTED furniture is peculiar to England, and when well made and finished is extremely suitable for bedrooms: it at any rate represents articles made of the best kind of wood for such usage—namely, light, bright-looking woods instead of ebony, oak, mahogany, &c., which are highly effective and more suitable for other purposes. Since the taste arose for furniture made of pine and other kinds of wood merely varnished, much improvement has taken place in the finish of painted furniture. The example here given is of the first class: it was exhibited in Paris by Messrs. Dyer and Watts, of London, and purchased by the ex-Empress of France. The wood here represented is maple, and the ornamentation is executed in dark-red colour so neatly as to have the effect of inlaid wood: not that painted ornament should be made to imitate inlaid work; on the contrary, it is capable of effects quite beyond the reach of marquetry.

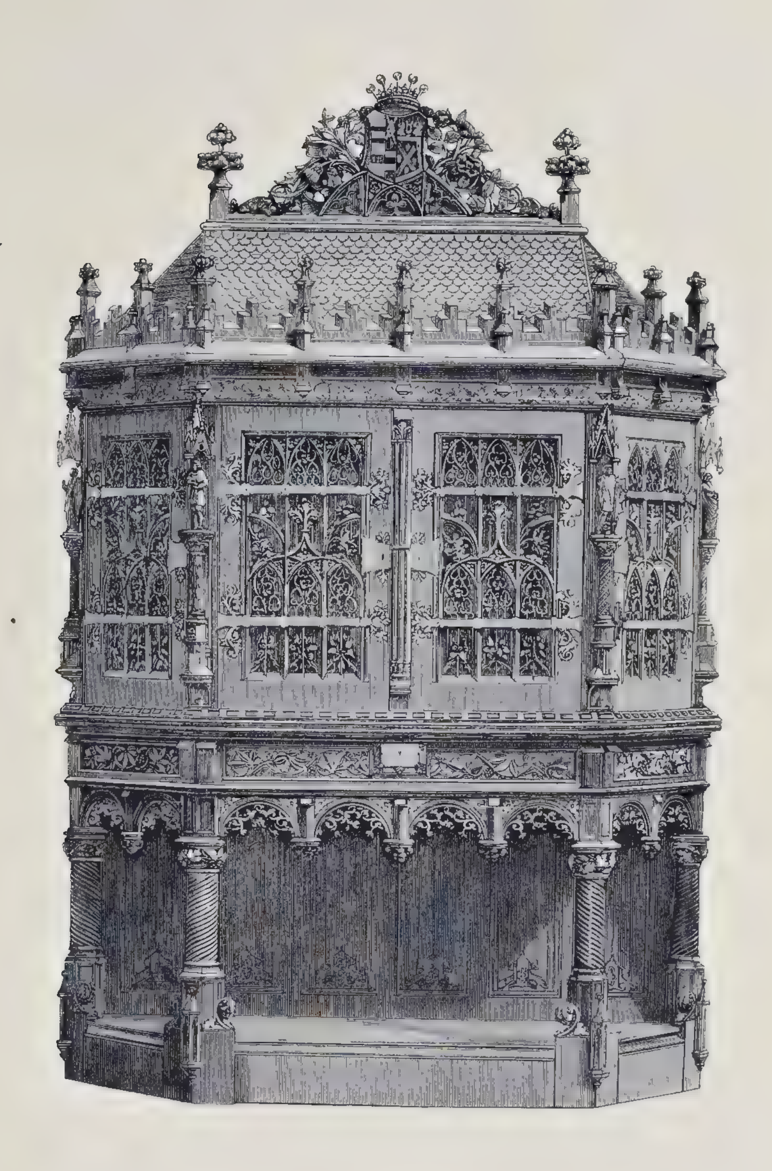




FRENCH AND ENGLISH DECORATED WORK.

THE grand ebony Cabinet represented in the lower figure is the work of one of the eminent *ébénistes* in Paris, M. Grohé, who has been a prominent and highly successful exhibitor: with such an example as the present before us, it is needless to say M. Grohé bestows a vast amount of Art on his works; the decorations of this cabinet are rich and beautifully fanciful and novel in arrangement and detail, and every part is worked out with exceeding care—take, for instance, the beautiful feet which support the cabinet—although it must be admitted that flowers are not in their place there.

Quite equal in its own style, affording a striking contrast to its companion, is the delicate Étagère above, by Messrs. Wright and Mansfield, of London; it is a charming example of a style seldom adopted now, that of the English of the eighteenth century, and is carved with great delicacy and richly gilt. A still finer example, a dwarf bookcase, in the same style by the same firm, will be found amongst our illustrations.



FRENCH CARVED OAK CABINET.

A REMARKABLE adaptation of the Mediæval style, by MM. Mazaroz, Ribaillier & Co., of Paris, who have obtained much reputation by their carved oak furniture. As in many famous shrines in churches on the Continent, we have ere an adaptation in wood of a pavilion in stone, with tiled roof to keep out the rain, where no rain can come, but the esigner has not fettered himself in other respects. The sloping sides do away with the heaviness which almost always ccompanies square furniture. The carving is admirable, and the hinges and other metal work are carried out with rue artistic spirit. This beautiful Cabinet was made for the late Countess Waldegrave, and although false in Art, it s a fine piece of woodwork. The Parisian *ébéniste* generally cares nothing for the principle of Art here infringed.



FRENCH EBONY CABINET.

ONE of the most beautiful cabinets produced in our time in France or any other country, a work in ebony, by Fourdinois. It appeared at the International Exhibition of 1862, where it was one of the greatest attractions, and went thence to Fonthill, the residence of Mr. Alfred Morrison, who purchased it, but who gracefully allowed it to be exhibited in Paris in 1867 as a *chef-d'œuvre* of Art-manufacture of the nineteenth century. The design is an excellent adaptation of Italian Art at its best time, and the bas-reliefs may be taken as an example of the value that can be given to wood by the true artist; they are perfection. In fact, every portion of the marvellous cabinet is a study. Those who have the opportunity should try to see it; those who have not, will find at the South Kensington Museum other of M. Fourdinois' works, differing in kind but also worthy of his high reputation, and of one of which an engraving is given on another page.





FRENCH INLAID AND ENGLISH BUHL WORK.

THE Cabinet is one of the many admirable productions of an eminent *ébéniste* of Paris, M. Lemoine, who has contributed largely to the stock of beautiful Art-work. It is composed of pear-tree wood, carved with great skill, and ebonized or stained black, and all the medallions as well as the inlaid ornaments are most delicately executed in ivory: altogether a work of striking merit. The faults in the design are the fractions of pediment, which are unmeaning, and the elbows of the two supporting figures, which are ungainly.

The other figure is that of a graceful Clock-case, the ornamentation being in Buhl-work of brass and tortoiseshell, by Messrs. Brunswick, of London, who, if they did not absolutely revive this peculiar kind of work in this country, have produced such admirable specimens that they fear no rivalry. Some other and more important examples of this sort of work by the same firm will be found on other pages.





DRESDEN AND PARIS WORK.

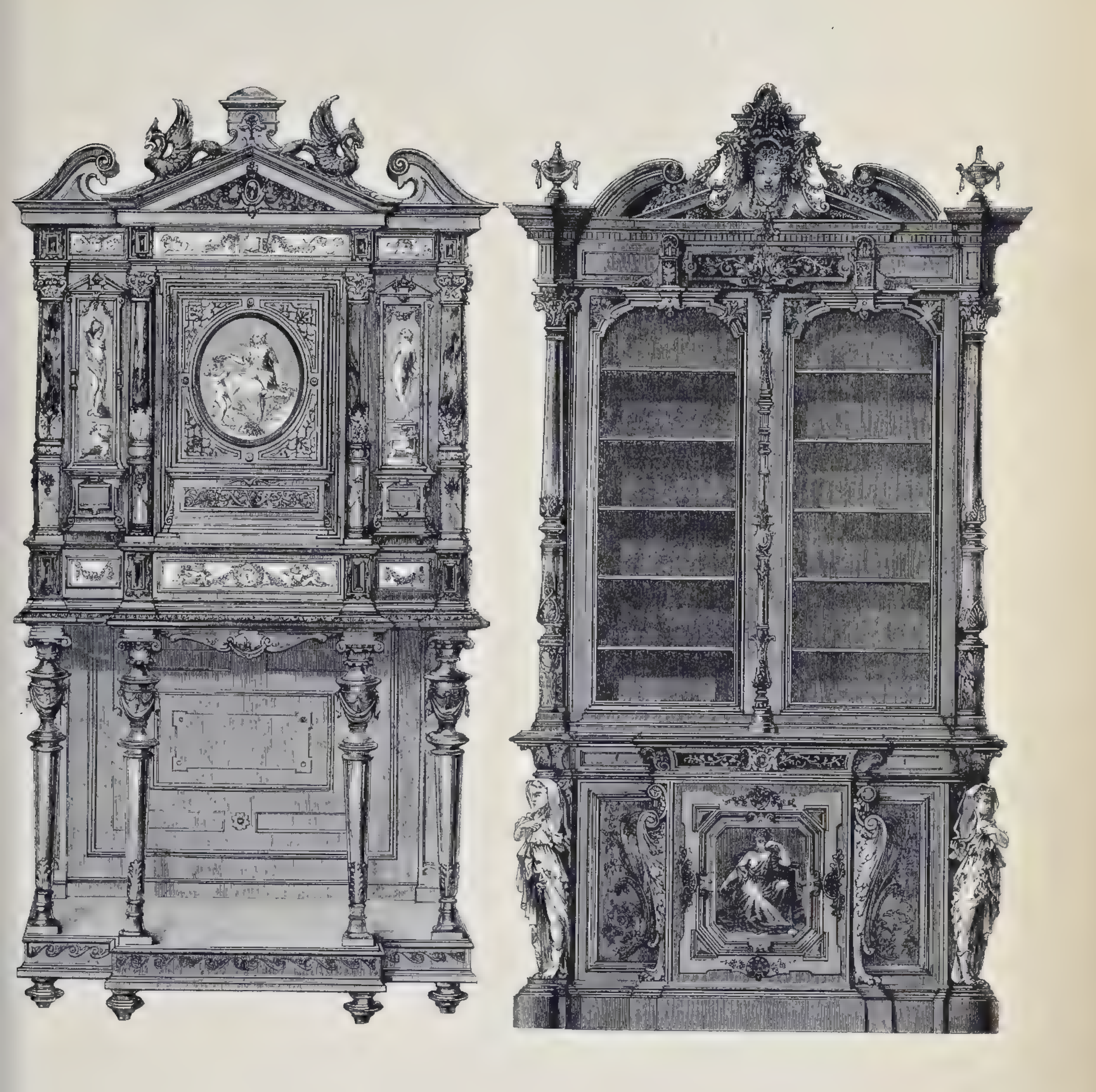
THE larger Cabinet on this page is the work of a famous manufacturer, the most important, we understand, in Saxony, Herr Turpe, of Dresden, who has earned a well-deserved reputation for ebenistery of the highest artistic character. This Cabinet is formed of ebony, but the whole of the carving is in pear-tree wood. The figures and the bas-reliefs are most delicate, both in design and execution.

The smaller Cabinet and Clock are in Buhl-work, which, after having been almost entirely abandoned for a century, has been revived with success, though not on a large scale, in Paris. The present productions are the work of MM. Pecquereau and Son, and are charming specimens of the revived art in metal and tortoiseshell inlay: the forms are peculiarly graceful, and the ornamentation bold and rich.



ENGLISH INLAID WORK.

A PIECE of work of chaste yet striking beauty, by Messrs. Jackson and Graham, of London, whose productions have greatly enriched our pages. Regarding the border of the Table above in mere black and white, the design is eminently beautiful, and shows the delicate taste and skill of the artist, Mr. Alfred Lormier. The table is of Amboyna wood, which has a beautiful curly grain, inlaid with all sorts of choice wood. The Amboyna wood of the centre is of the lighter kind, and around this is a delicate running border of bay leaves in boxwood; the border itself consists of bands of various coloured woods, which enclose the beautiful scrollwork shown in the engraving, and which, like the bay-leaf ornament, is in boxwood, with a ground of darker Amboyna than that of the centre. An ebony moulding frames the work. Composed of the choicest materials, and exhibiting perfect workmanship, this formed one of the most beautiful and truly chaste examples of decorative furniture at the Paris Exhibition of 1867, and was a worthy forerunner of the exquisite productions which obtained the firm the highest honours of 1878.



PARISIAN EBENISTERY.

TWO fine works by eminent hands. That towards the left hand is the production of M. Rudillon, of Paris; it is peculiarly French in style, and the design is carried out with much delicacy and skill: it is composed of ebony inlaid with ivory, carved and engraved, and with ormolu mouldings and ornaments. The insertion of sculptured ivory in this manner has been brought to wonderful perfection in Paris of late years, and it is impossible to praise some of these exquisite decorations too highly. The human figure is of course the touchstone of the sculptor, and when executed, as in this instance, in bas-relief, and in a fitting substance such as ivory, the effect is most graceful.

The second Cabinet is by MM. Guéret Frères, of Paris, whose reputation, especially for carving in wood, has long been established—a fact which is not surprising, considering that the brothers were trained in that truly artistic school, the *ateliers* of M. Fourdinois. The present example of the work of this firm is very beautiful, but others will be found in our pages which are equally so.



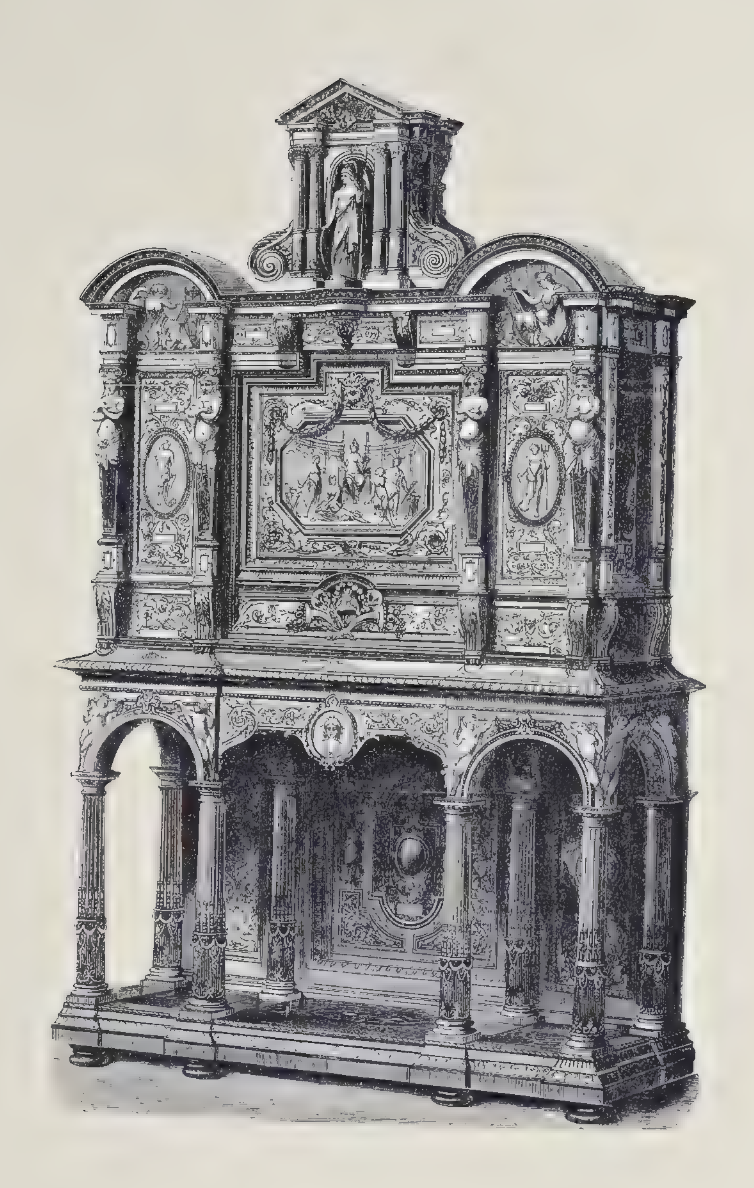
SCOTCH EBONIZED CABINET.

MESSRS. RICHARD WHYTOCK & CO., of Edinburgh, have long been noted for the excellent taste and execution of their furniture, but they have rarely, we think, been more successful than in the present instance. The Cabinet before us is not formed of expensive wood, pear-tree probably, but stained to represent ebony; there is no attempt at very elaborate ornamentation—which is really less pleasing in a drawing-room than in a museum—but the design and all the details are elegant and in pure taste, and the result is a beautiful piece of furniture on which the eye may rest without being dazzled. We have over and over again condemned the architectural pediment in woodwork, but in this instance, as in the case of the semicircular tops of the glazed doors, it is used as an ornament, and not a sham feature of construction.



ENGLISH CARVED EBONY.

A NOBLE Cabinet in ebony by one of the leading firms of this country, Messrs. Trollope, of London. The designer has not attempted to compete with the elaborately decorated works of the *ébénistes* of Paris, covered with bas-reliefs, each of which would, not many years since, have been considered a work of high Art to be exhibited by itself, and worth its weight in gold; but in grandeur of design, in the beauty of the details, and in the purity of taste which pervades the whole the work could scarcely be surpassed, and the execution of the carving is worthy of the design. The mouldings below are beautifully bold and in perfect keeping; the top is the top of a cabinet fit to accommodate a bust or any other work of Art, and without the triglyphs would have been exceptionally good.



PARIS CARVED EBONY WORK.

ANOTHER of M. Fourdinois' marvellous works. We have already noticed several, each perfect in its way, and we will therefore quote what was said of this Cabinet in the *Art Journal* at the time of the Paris Exhibition of 1867:—
It is impossible, either by pen or pencil, to do justice to the Cabinet of M. Fourdinois, the *chef-d'œuvre* of the Exhibition, nd certainly the best work of its class that has been produced, in modern times, by any manufacturer. But it is not a roduction of manufacture, not even of Art-manufacture; it is a collection of sculptured works, brought together and nade to constitute parts of a cabinet—these 'parts' all exquisitely sculptured; 'carving' is not a word sufficient to express heir delicacy and beauty. We engrave it; yet no engraving, however large, could convey an idea of the perfection of his perfect work. The *grand prix* has been allotted to M. Fourdinois, and, we believe, by universal consent of his ompeers, for this, his latest and best production, is unrivalled."



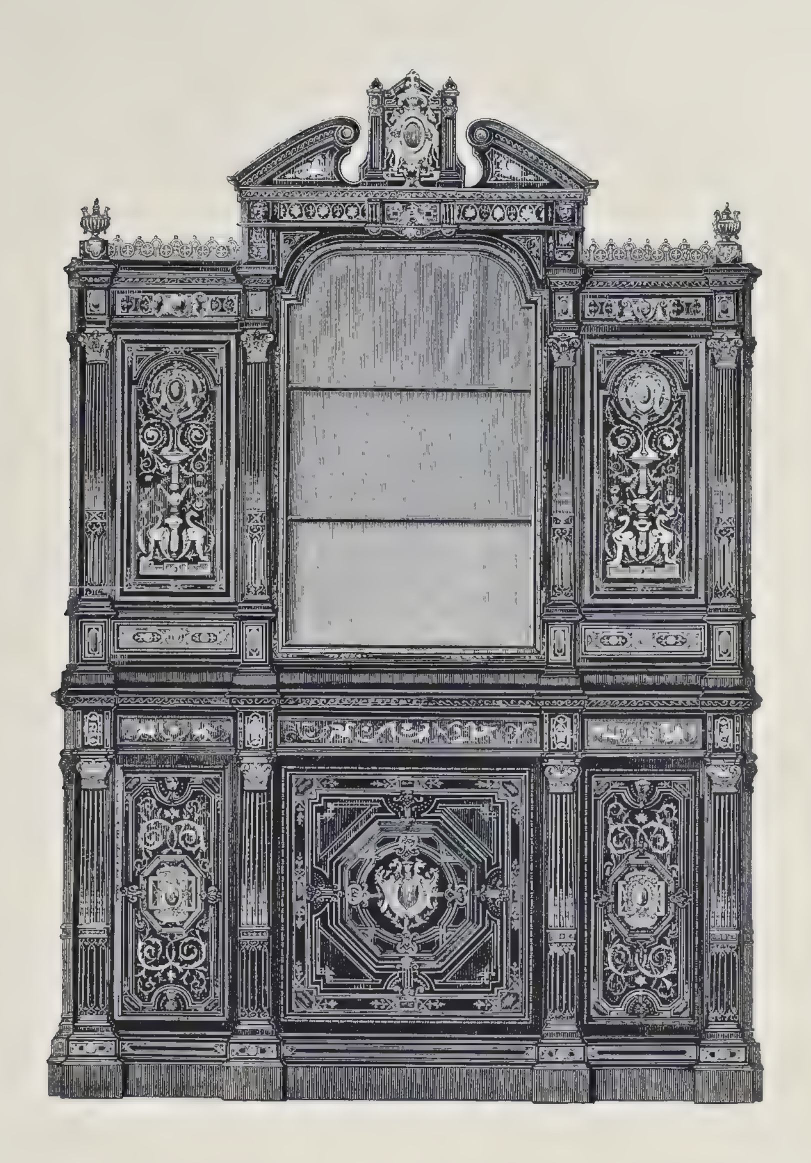
GERMAN OAK CABINET.

AN elaborate piece of carved work by Herr Hentenger, of Mayence. With less ornamentation the general effect would have been better. When there is superabundance of ornament, some portions are almost sure to be imperfectly carried out: then, again, oak is not fitted for elaboration, but for boldness of treatment. Some of the details are unfortunate; for instance, the large birds below—emeus, we suppose—which seem to be coming through fissures, the odd urns to the right and left of the principal figures, and the grotesque heads opposite to the urns. Still there is considerable merit in the work; the general form is graceful, and the mouldings and other ornaments good.



FRENCH CABINET, WITH BRONZES.

THIS engraving represents an example of a peculiar style of decoration, which, as far as we know, is adopted only by one distinguished *ébéniste,* M. Diehl, of Paris. The ornaments are executed in cast and oxidized bronze, and with ebony and some other kinds of wood they produce an admirable effect. The bas-relief in the present case is remarkably spirited; the subject is the triumphal ride of the Merovingian conqueror of Attila over the field of battle, in a car drawn by wild oxen, thus subduing the beasts as he had his ferocious antagonists. The arms, the yoke, the ox-heads, the wreaths, &c., are admirably employed in the trophies which decorate the upper part of the Cabinet. An original and very remarkable piece of decorative work.



LONDON INLAID EBONY WORK.

)NE of the most superb pieces of decorative Cabinet work that we have to present to our readers, the production of Messrs. Jackson and Graham and their chief designer, M. Lorimer. A Cabinet very similar to this was exhibited by ie same eminent firm in Paris in 1867. An engraving has already been given in these pages of a portion of this Cabinet, ith some of the details on a large scale; but such a masterpiece as this occupies a long period in execution, and we elieve the work was not shown in its entirety till it appeared at the International Exhibition of 1871. It is not a slavish ›py of any other work, or indeed of any style, but an application of Italian Renaissance of the sixteenth century, :hibiting highly cultivated taste and great ability. It is executed in ebony, inlaid with ivory, and relieved with lapis-zuli and red jasper. We know not in whose possession this sumptuous example of Art-manufacture is now.

With few exceptions, the illustrations that follow all belong to the present decade, or, more exactly, to the period nce 1867.



ENGLISH MODERN MARQUETRY.

HE most remarkable example of marquetry produced in this country, and probably not surpassed, if it be equalled, by any modern work of the same kind. It forms the top of a table, which was designed for the Duke of Northumberland by r. C. P. Slocombe, of the South Kensington Museum, and was highly commended by the late admirable artist, Daniel aclise. The subject of the composition is the Five Senses, and the amount of imagination and skill exhibited in the tails is very striking. Besides the knowledge required to design such a piece of work in various colours so as to produce ective harmony, the skill required to fit in the innumerable pieces of this artistic puzzle is great; every portion must be ometrically correct to the main lines of the design, or the effect would be completely marred. The work was not all ected by one hand; it was commenced by Mr. Henry Blake, who did not live to complete it, and was finished by Mr. Vert.



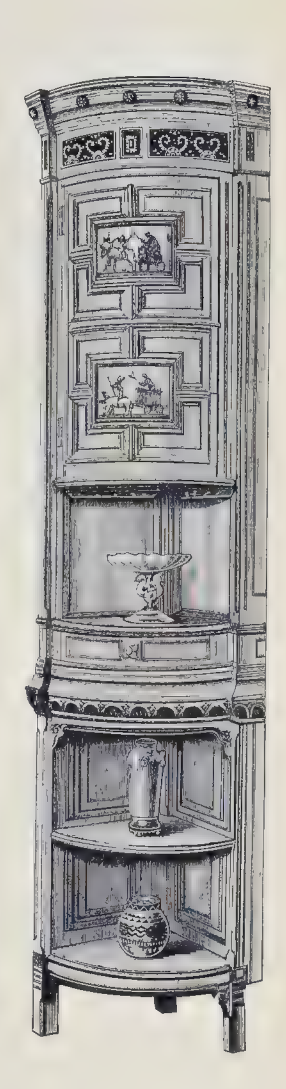


SAXON AND ENGLISH CARVED WORK.

THE first illustration is a remarkably handsome Cabinet in oak, by Herr Friedrick, of Dresden: it is a work of decided merit, showing knowledge, judgment, and skill; every portion is studied and carried out with care, there is neither redundancy nor bareness. This was exhibited in 1867.

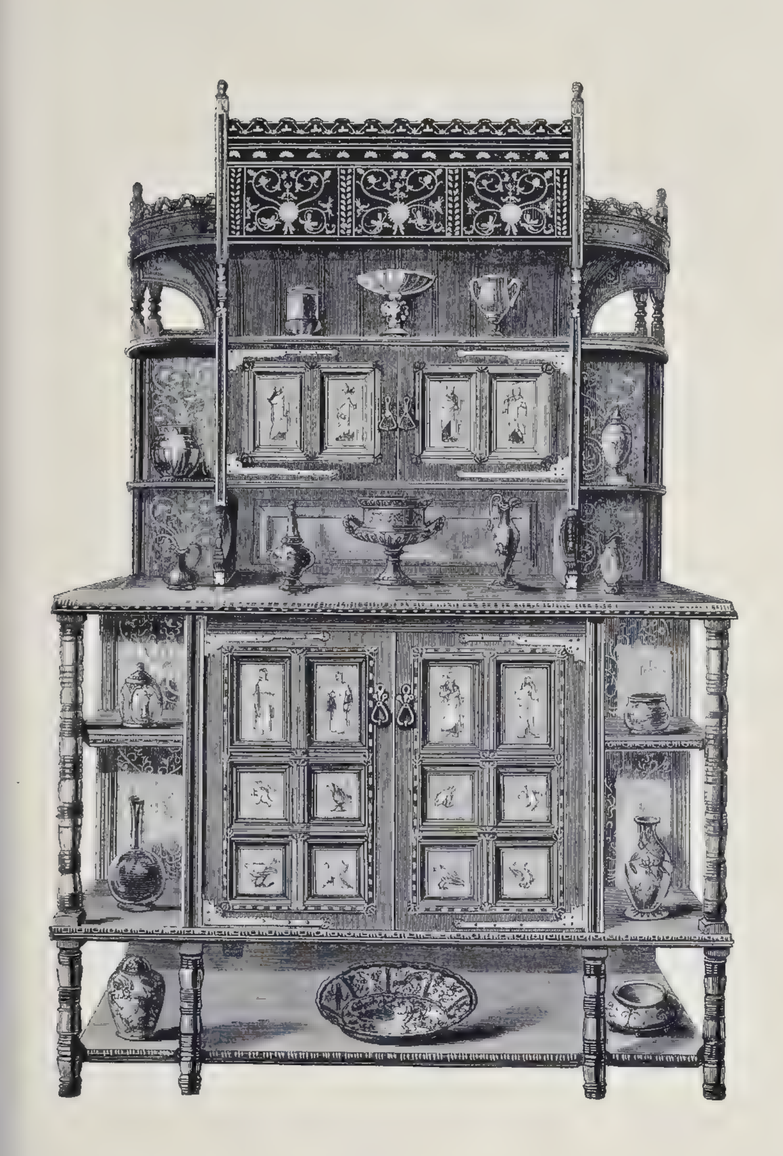
Totally different but equally good is the other Cabinet, shown by Messrs. Wirth Brothers, whose charming works at the International Exhibition of 1871 have already given us several illustrations. Here again we have excellent effects produced without any excess; there is not an atom of redundant ornament in the whole composition. The use of the scrolls in place of capitals and bases is refreshingly novel and ingenious. As to the beauty of the carving, we need only repeat that it is from Messrs. Wirth's establishment.

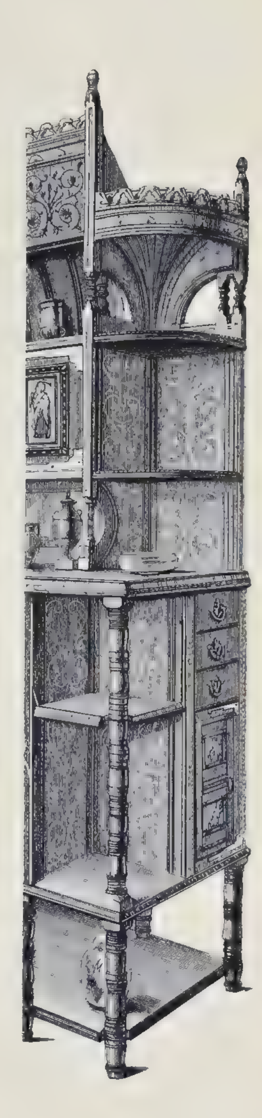




LONDON DECORATED WORK.

THE Cabinet of which the front and one side are given in the engravings above was shown, with other beautiful productions, at the International Exhibition of 1871, by Messrs. Collinson and Lock. The design is by Mr. Talbert, and exhibits not only much originality but admirable artistic feeling throughout. The work is in satin wood, inlaid with rare woods of various colours, and the effect is heightened by gilding in parts—for instance, the bars of the upper doors and the colonnettes are gilt, and the former enclose thick panels of glass with chamfered edges; the panels of the pair of doors below are decorated with fine marquetry. The quarter-circle panels above are also richly panelled and partially gilt, and these four panels contain charming pictures of the Seasons by Mr. Andrew B. Donaldson.





LONDON PAINTED WORK.

AN elegant Cabinet and Etagère combined, contributed by the eminent firm of Collinson and Lock to the International Exhibition of 1871: the style is old, but the details of construction as well as the mode of decoration present points of originality. In the first place the construction is well carried out by rendering the side fronts integral parts of the cabinet; this is well shown in the smaller engraving, which shows one side of the work; the upper compartment is very elegant, and is well given in both engravings. The peculiarity in the decorative portion is that panels and mouldings are alike painted by hand in the best manner. Altogether the effect is highly satisfactory, and does great credit both to Mr. Calcott, who designed the woodwork, and to Mr. Woolridge, who decorated it. We shall offer examples of pictorially ornamented furniture of other kinds.



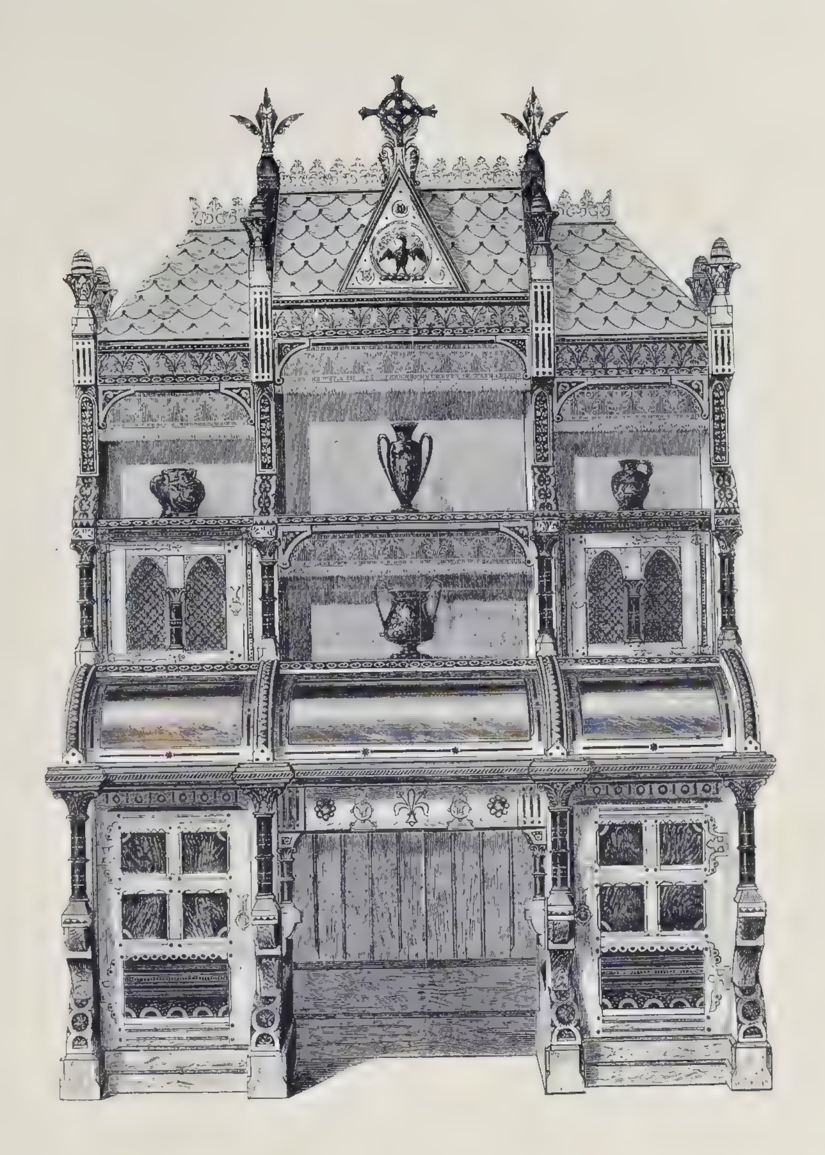
LONDON DECORATED CABINET.

AN elegant satin-wood Cabinet for a drawing-room, manufactured by Mr. William Walker, and shown at the International Exhibition of 1871: like several other cabinets and sideboards noticed in these works, it partakes somewhat of the dressoir and the étagère. This is a great advantage, as the usual form of cabinet being closed by doors cannot present the same attractive appearance as one glistening with choice examples of porcelain or other *objets de vertu;* there is a certain amount of originality in the general form, and the colonnettes are very graceful. The cameo ornaments are gilt, but the scroll-work is delicately painted by Mr. John Turner, the artist of the establishment, to whom the design is also due.



LONDON "OLD ENGLISH" WORK.

A CABINET remarkable at once for originality of arrangement and characteristic features, by Messrs. Collinson and Lock, who have given great attention to this old style, and the success of whose efforts has been evinced, in one nstance at least, by the purchase of a work which they exhibited in 1871 for the South Kensington Museum. The form f the lower part of the cabinet presents nothing remarkable; the insertion of the glass above is original and effective, and hat of the semi-circular supporters is very happy. The cabinet is constructed of ebony, or ebonized wood, as the ngraving shows, but the peculiar beauty of the ornamentation could not be given in printer's ink; the general decoration s incised, sunk into, not raised on the surface of the wood, and then gilt, a method which gains what we may perhaps ot inaptly call sober brilliancy, while the gold is well protected from friction. The general effect is also much heightened y the subjects, birds and flowers, painted on the four panels below: these are executed in colours on a gold ground. he cabinet was exhibited in 1872.



ENGLISH MODERN MEDIÆVAL WORK.

A VERY remarkable Cabinet, the work of Messrs. Collier and Plucknett, of Warwick—who sustain the reputation of their predecessors, Messrs. Cookes—and designed by Mr. J. Plucknett. Eminently original in form, it is conceived in thoroughly Mediæval spirit. The form is perfectly represented in the engraving, but the composition of the work requires description, as it is rather elaborate. The body of the cabinet is of solid oak; the columns, or rather colonnettes, are of polished ebony—recalling the columns of Purbeck marble in several of our cathedrals and old churches, and their capitals of light-coloured oak producing a like contrast to that of the white stone and dark marble. The surface is relieved by carving in the body of the oak and inlaid work in various ornamental woods. The shelves are further decorated with hanging borders of rich purple velvet embroidered with gold thread. This noble cabinet was constructed to contain illuminated MSS. and other valuable works of Art, the property of the Rev. Chafy Chafy. The effect of the whole is immensely increased by the introduction of beautiful objects in the upper portion. It was exhibited in 1872.



ENGLISH ETRUSCAN INLAID TABLE-TOP.

A BEAUTIFUL and useful kind of production, shown by Messrs. Jackson and Graham at the International Exhibition of 1872. In poor black and white the beauty of the design is striking, and we know no other example of Etruscan to compare with it: it is a style which often runs with mere conventionality, and becomes thready and meagre in effect; but here the ground is admirably covered, though not overladen with ornament. The work itself is brilliant; the ground is of olive-wood, and the inlays of green and black ebony, and the contrasts are charming. The execution of a large surface of inlaid work like a Table-top is a very difficult operation, especially in the case of strictly geometrical designs like this; the slightest departure from accuracy in any important element would mar the whole effect, and when we consider the enormous number of pieces to be dealt with, we can appreciate the care necessary. We are not in the secret of fret-working, but we suppose that some aid is got from geometrical arrangement—for instance, the veneers may be cut in four parts superposed, the Table for this purpose being divided into quarters through the four angles of the square in the centre; this would give uniformity, which is one element, and a not unimportant one in such a work; but nothing but true artistic knowledge and feeling can give life to such a work as this. The top is mounted on a central pillar and four small pillars mounted on claws, and these are all decorated in the same manner as the top.



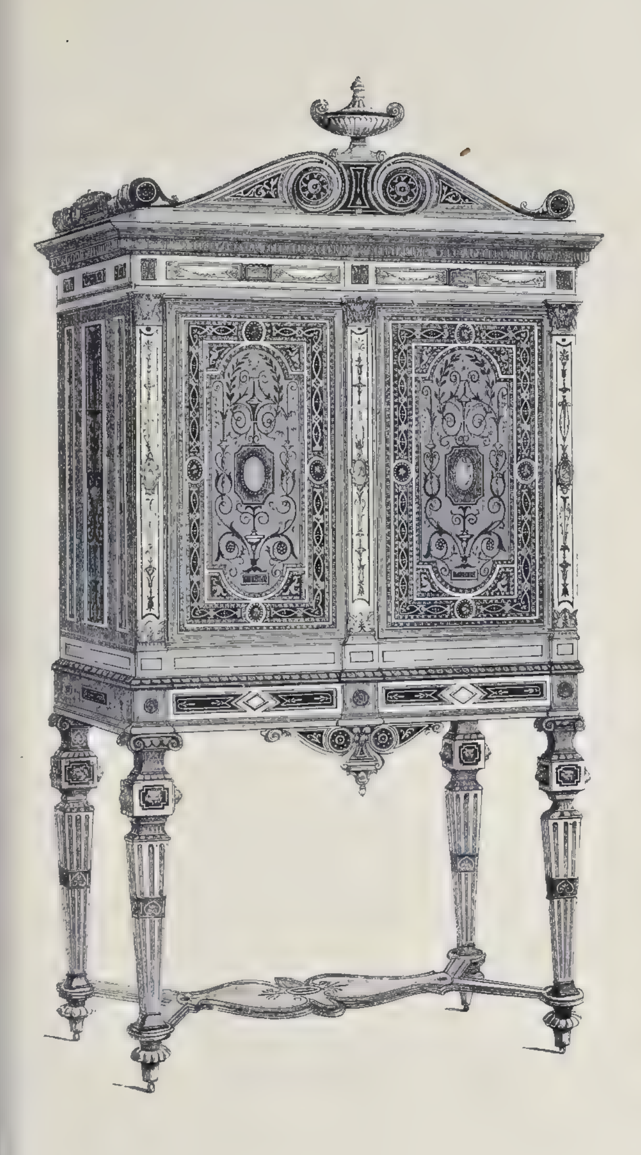
ENGLISH DECORATED OAK WORK.

THIS Sideboard, or rather, we should say, *Dressoir*, for the main object is evidently the exhibition of plate and porcelain, was designed by Mr. Edward J. Turner, architect, and presents a highly skilful and effective adaptation of old style. The cornice covering and brackets above are peculiarly elegant, and the solidity of the lower portion, as compared with the graceful lightness of the upper, is very effective. The projection of the central portion of the work below at once varies the outline, gives opportunity for two pretty little niches and brackets, and supplies useful additional space to the Sideboard. This fine work was exhibited in 1872 by the eminent firm of Morant, Boyd, and Blandford, who have accustomed us to beautifully designed and highly finished work.



ENGLISH TOILET TABLE.

THE elegance of a well-furnished English bedroom is proverbial, as well as the comfort, and the charming Toilet Table here given is the production of a firm that has contributed largely to the elegance and comfort of the bedrooms of the opulent, Messrs. W. and J. R. Hunter, of London. This Table is truly a useful article rendered beautiful, not a mere show-piece: the drawers and small cabinets above afford ample accommodation for all requisites, with, perhaps, a few superfluities, while beautiful form and colour are superadded. The wood employed is Hungarian oak, with panels of harewood, the whole being decorated with plaques and cameos of Wedgwood ware. The design is from the pencil of Mr. G. W. Fairbank.





ENGLISH AND BELGIAN DECORATED WORK.

THE first engraving is of a remarkable piece of work exhibited by Messrs. Brace, of London, in Paris in 1867, and it reflects great credit upon that well-known firm. This cabinet is both constructed and inlaid with various kinds of wood, with ivory and ormolu, selected with great care. The door panels are of satin wood, inlaid with coloured woods; between the panel and frame are margins of ebony inlaid with ivory; the frame is of purple wood, and the mouldings of ormolu; the pilasters are of ivory delicately inlaid with dark wood, a rare but beautiful method of ornamentation, and they have bases and caps of ormolu. The style is the Quinque-cento, treated rather classically.

The second Cabinet presents a curious contrast in style, form, everything but merit; M. Snyers-Raug, of Brussels, has a high and well-deserved reputation, and all his productions have an artistic stamp. That here represented is no exception; the elements are old, but the treatment is original, and to our taste very effective; the drawing and carving of every portion are admirable; the whole is executed in oak. It was exhibited through Messrs. Bontor and Collins in 1871.



ENGLISH EBONY AND IVORY WORK.

ANOTHER example of the admirable productions of Messrs. Jackson and Graham, who have supplied us with so many worthy specimens of English Art-workmanship. In this case we see an instance of true classic taste, held in perfect subjection, and the effect of the work made to depend on apparently the simplest means: the proportions are charming to the eye, the inlaid ornaments are peculiarly chaste, and being executed with uncommon care have a delightful effect. The contrast between the ebony and ivory is charmingly relieved by the porcelain plaques in the panels; these are executed in the highest manner of keramic decoration, that is to say, by the process of *pâte sur pâte*, which may be described in a few words as modelling figures on the surface of the ware in white or other paste of clay. It requires a well-practised and steady hand to succeed in this beautiful form of decoration.



ENGLISH SATIN-WOOD AND IVORY.

SATIN-WOOD has always been a favourite material in England, with and without dark-coloured inlays ; but satin-wood inlaid with ivory, and with carved work also in ivory, is an uncommon combination, but a very beautiful one. This elegant piece of boudoir furniture, a Wardrobe and Toilette-table combined, is the work of Mr. William Walker, of London, who has produced many pieces of beautiful cabinet-work. The design is by Mr. R. Charles, who has distinguished himself in his art. It may be mentioned that the central portion has two trays adapted from the wedding coffers of the Italians.



ENGLISH DECORATED OAK SIDEBOARD.

A NOBLE piece of furniture for the great dining-room of a country mansion, in Mediæval style, by Messrs. Cooper and Holt, of London: it is formed of oak inlaid with various other kinds of wood, and brilliantly decorated with painted porcelain and tiles. The form of the Sideboard is good, and the arrangement below the slab highly effective, the closed cupboards and the open spaces relieving each other capitally, and furnishing accommodation of all kinds. The illustrations on the porcelain all refer to the chase or sport of some kind; the *plaques* above the slab exhibit two spirited sketches of waterfowl: the artist has not condescended to dead game. This fine piece of furniture attracted much attention at the Vienna Exhibition.



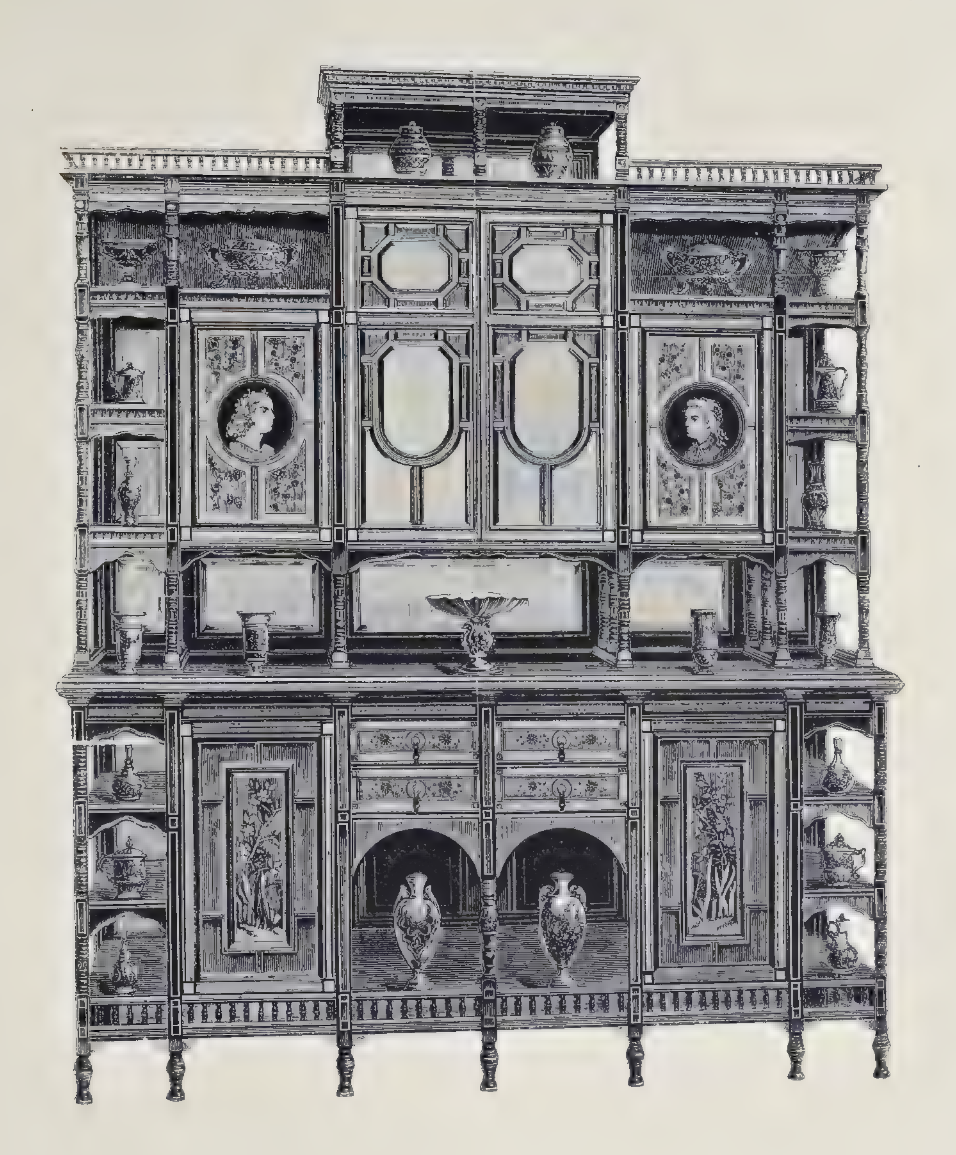
ENGLISH TOILET-TABLE.

THIS light and elegant Table is of American birch and ebony, with circular inlays of various other kinds of wood; the panels are decorated with subjects photographed on the wood by a process patented by the manufacturer, Mr. Arthur Foley, of Salisbury. The table is somewhat similar in form to others we have illustrated. The small cabinets on the top of the table are conveniently placed for use, and serve as supports to the glass as well as the candelabra. The only objection that strikes us is that the cross-bars below with the urn are in the way of the feet of the sitter; a padded rail for the feet would have been better. The design is by Mr. H. Dickenson.



SILVER, GOLD, AND STEEL MIRROR FRAME.

WE devote three pages of the remaining illustrations in this section to as many of the *chefs-d'œuvre* contributed by Great Britain to the Philadelphia Exhibition of 1876. For some reason, only one English worker in the precious metals sent anything; but that one, Messrs. Elkington, contributed a dazzling collection. Amongst the beautiful objects one belongs to furniture, and is at the same time one of the most exquisite productions of modern times. It is the work of M. A. Willems, the highly accomplished artistic director of the firm. This elaborate work, it should be mentioned, is about two and a half feet in height and one and a half feet in width, or four times the size of the engraving. This will give some idea of the enormous amount of work lavished upon it, and at the same time enable the student to partially realise the effect of the ornamentation. We have not space, nor is it necessary to say anything about the beauty of the general design—that is evident to all. The frame generally is of silver; but this is beautifully relieved by the introduction immediately around the mirror itself of a broad border of steel bronzed to a dark tint, and elaborately damascened with silver and gold wire. Had not the Milton Shield, the Helicon Vase, and other magnificent works prepared us for it, we should have found it difficult to imagine that the so-called prosaic nineteenth century could have produced such a work.



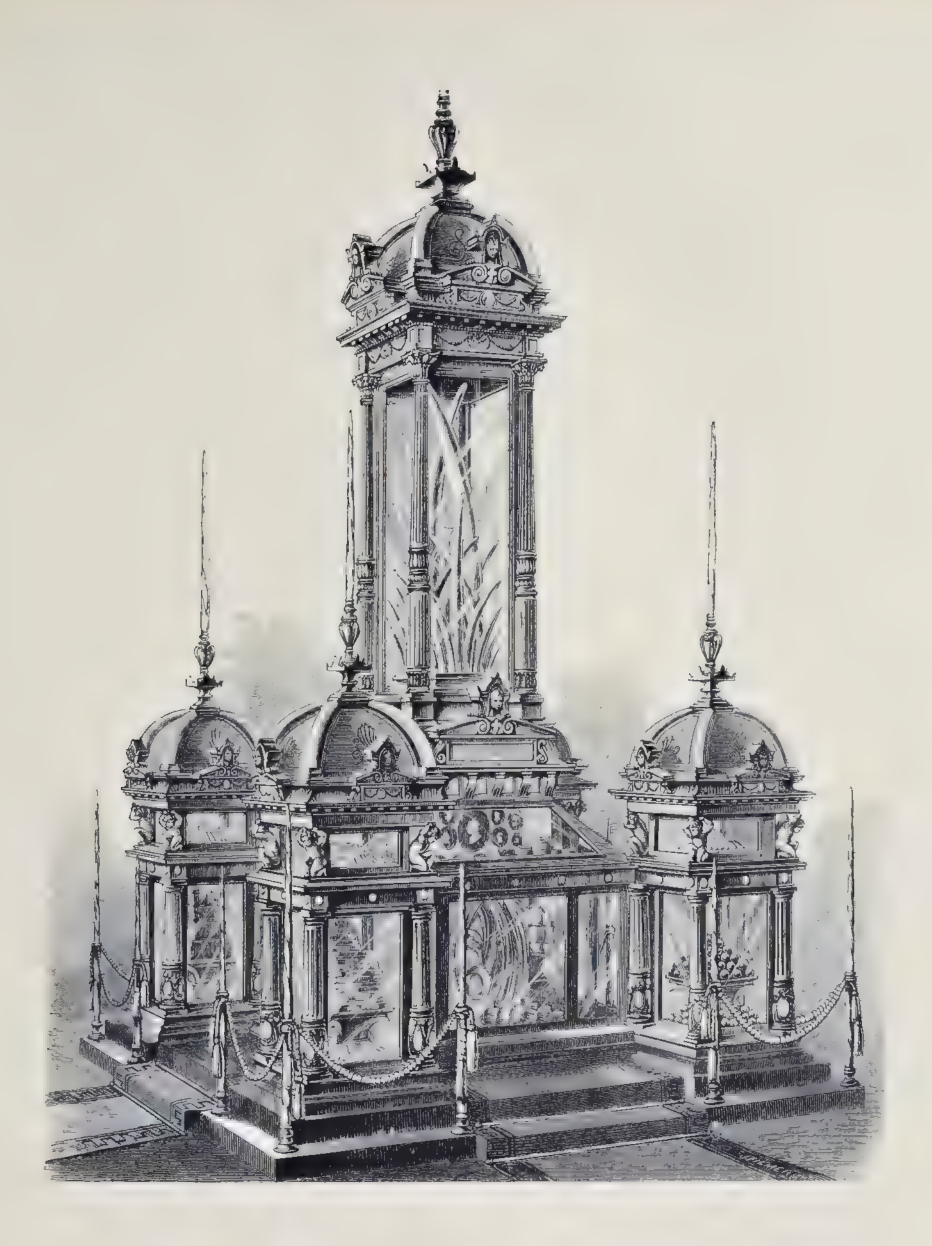
ENGLISH DRAWING-ROOM CABINET.

WE regret that we can only find space for one or two other examples of British cabinet-work contributed to the Philadelphia Exhibition, but they are worthy of the immensely improved condition of decorative work. This beautiful Cabinet, which is the work of Messrs. Cooper and Holt, of London, has a black foundation, with panels of richly coloured woods—Amboyna, delicate grey harewood, satin and purple wood, white, and low-toned green—and these are again contrasted with silvered plate-glass panels of various forms, but all of brilliant material, and chamfered at the edges in the Venetian fashion. The effect of the whole is still further increased by the introduction of beautiful inlaid designs in the panels, and the judicious application of gold to the mouldings and turned portions of the Cabinet. This beautiful piece of cabinet-work received all the honours it richly deserved.



ENGLISH SATIN-WOOD AND MARQUETRY.

THE contributions of the great English cabinet-makers to the Vienna Exhibition were not very numerous, but the best specimens took very high rank, none higher. We give two illustrations, differing entirely from each other, but both admirable. This, our second example, is the production of Messrs. Collison and Loch, whose excellent taste and workmanship are well known. The Cabinet is designed with excellent taste and some originality; it is executed in satin-wood, inlaid with ivory and purple and other kinds of wood, and illuminated in parts by means of gilding. On the panels of the doors are two designs of flowers, which the scale of our engraving does not allow of showing effectively, designed and executed in marquetry with rare excellence.



GERMAN SHOW-CASE.

SHOW-CASES are not unimportant matters, and much skill has been exhibited by the Art-manufacturers of all nations in setting off their productions to the best advantage by means of show-cases or stands. That which is here represented was one of the most elaborate that appeared at the Philadelphia Exhibition. It was formed of wood stained in imitation of ebony, and fitted with fine plate-glass. The central portion was about twenty feet in height. The case was devoted to the exhibition of a magnificent collection of ivory, raw and in every stage and form of manufacture. The central shaft was filled with tusks, and amongst them were some of the finest ever seen. The use made of the horns of the narwhal was effective, and the connection of those forming the railing around the case by strings of ivory balls was a very ingenious idea. With this closes the list of our illustrations of furniture.





LYONS CLOTH OF GOLD AND GOLD BROCADE.

TWO examples of sumptuous tissues from Lyons. The first is a specimen of one of the most expensive and beautiful fabrics produced, known in France as *drap d'or*, of great substance, magnificent in colour, and the ground interspersed with threads of gold: the effect of these tissues is very brilliant. The design in this case too is admirable, both in its conventional and natural elements, all showing remarkably artistic decision of pencil. MM. Mathevon and Bouvard are the manufacturers.

The other figure represents an example of another tissue which rivals the former in magnificence: it is a rich gold brocade, equally a speciality of Lyons. In this case, again, the drawing of the roses and corn-flowers is admirable, and the arrangement of the parts of the design peculiarly original. This is the production of MM. Le Mire et fils. Both these charming fabrics were exhibited in 1851.





LYONS VELVET AND SILK DAMASK.

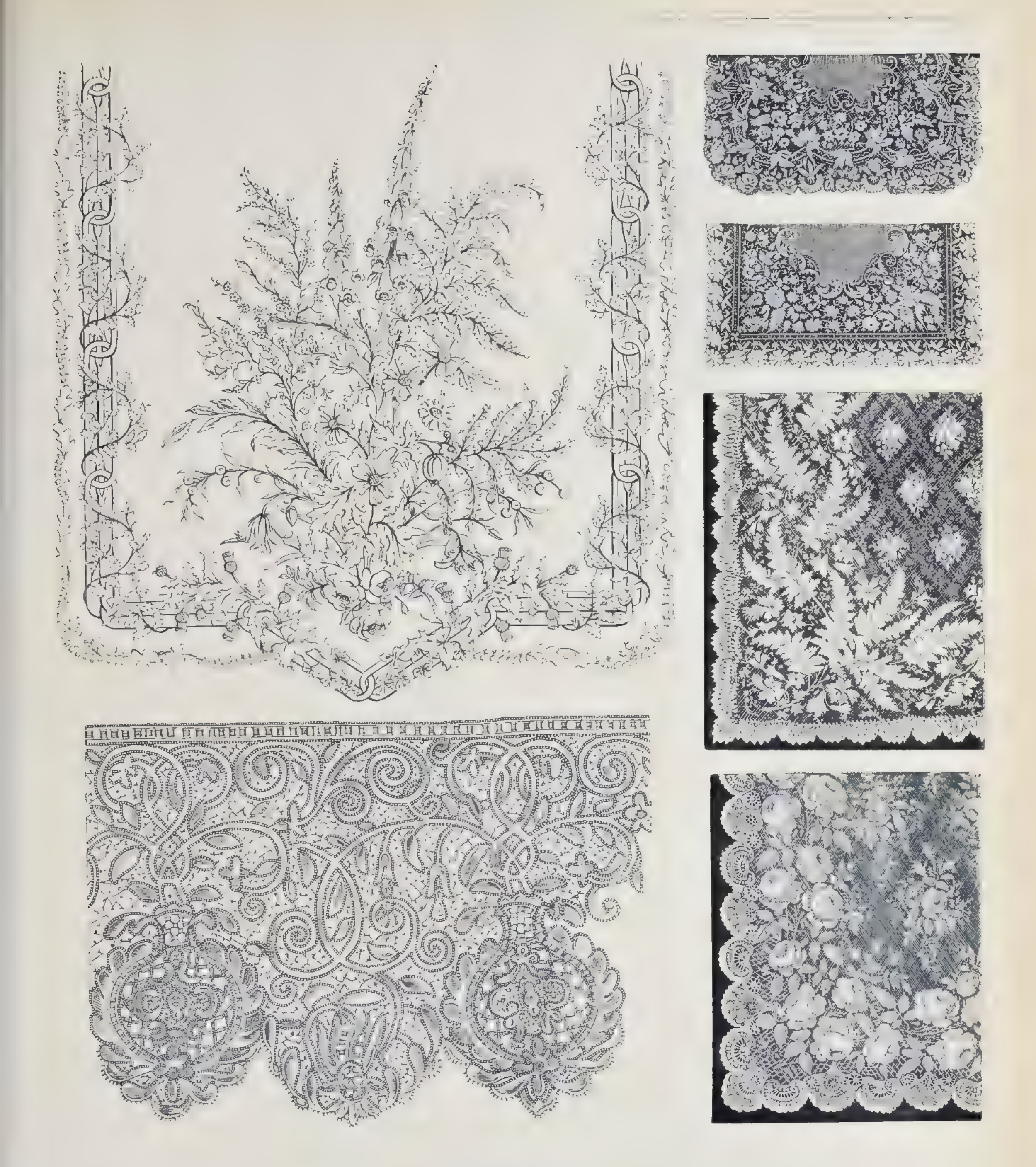
SPECIMENS of the exquisite productions of the looms of Lyons shown at the Great Exhibition of 1851 by MM. Mathevon and Bouvard. The figure to the left hand represents, in plain black and white, one of the rich and costly velvets for which Lyons is celebrated: the design is conventional, but thoroughly suited to its purpose. The other specimen is of silk damask, another of the specialities for which Lyons is unrivalled: the design is in every respect excellent, and peculiarly effective.



FRENCH, MANCHESTER, AND COVENTRY RIBBONS.

THE three which occupy the upper line are admirable examples of the manufacture of M. Grangier, of Saint-Chamond, and they date back as far as 1849 or 1848. The first presents a charming study of the field poppy, the ground of the ribbon being covered without being crowded. The formal leaf pattern, which stands next, sets off its neighbours admirably. The third is a fanciful floriated pattern, which, though much more complicated than the first noticed, is perfectly distinct and pure in design.

On the left below is an example by Messrs. Winkworth and Procters, of Manchester, which presents a pretty running design of corn and bindweed. The other two are the manufacture of Mr. C. Bray, of Coventry. The design of that in the middle presents a charming study of British flowers; the last has leaf-like divisions, with a peculiar style of border, and two very graceful bouquets of natural flowers alternating with each other.



ENGLISH LACE.

THE principal figure on this page represents the end of a white lace Scarf manufactured by Mr. Urling, of London, in imitation of Brussels point; it is ornamented with the rose, thistle, and shamrock, and a variety of British wild flowers in needlework. The straight lines of the border are embroidered in gold on a fine clear net, by a process which Mr. Urling patented. This example of textile work was prepared expressly for our first Great Exhibition, and the design, which is extremely graceful, was, we believe, by Miss Gann, then a pupil, but now principal of the Female School of Design.

The engraving below the former represents a piece of one of the most famous kinds of real lace in the world—that of Honiton—by Mr. Treadwell, who exhibited it in Paris in 1855. The pattern is rich and original.

Above, on the right-hand side, are two small figures of Handkerchiefs in Honiton Guipure, part of Messrs. Hayward's magnificent show of lace at the 1862 Exhibition, of which more important specimens will be found on other pages.

The two remaining examples are of Nottingham machine-made Lace Curtains, by Messrs. Thomas Adams & Co., who have supplied us with more than one other example of their beautiful productions.



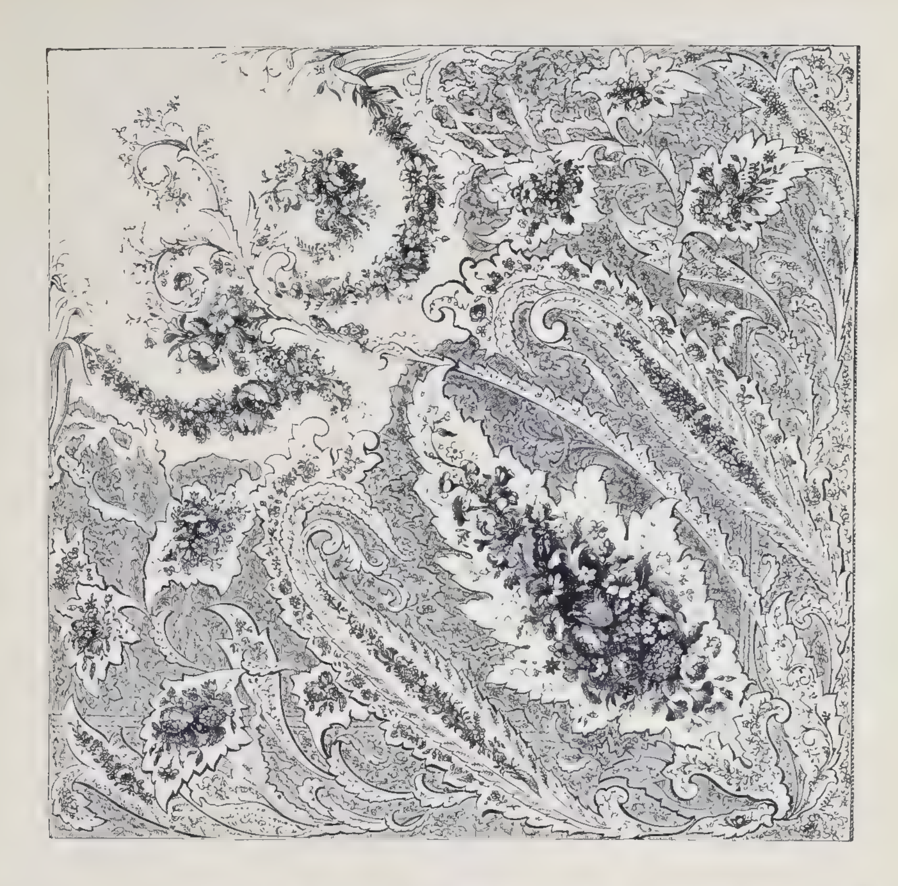


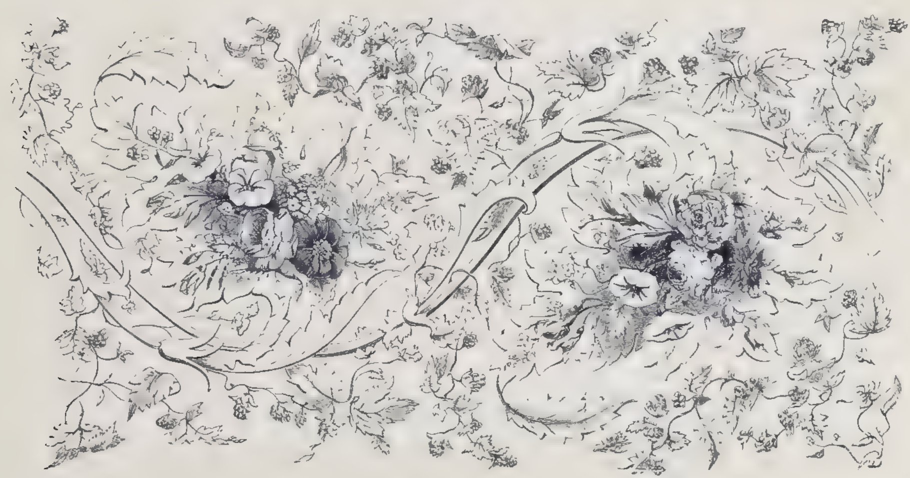
SCOTCH SHAWL.

THE first of our illustrations here is that of a Shawl by Messrs. John Morgan & Co., of Paisley: the pattern is rich and elaborate, reminding one in its main features of those of Cashmere; but the details are much closer to nature; the curved acanthus-like leaf is peculiarly effective.

BERLIN SILK STUFFS.

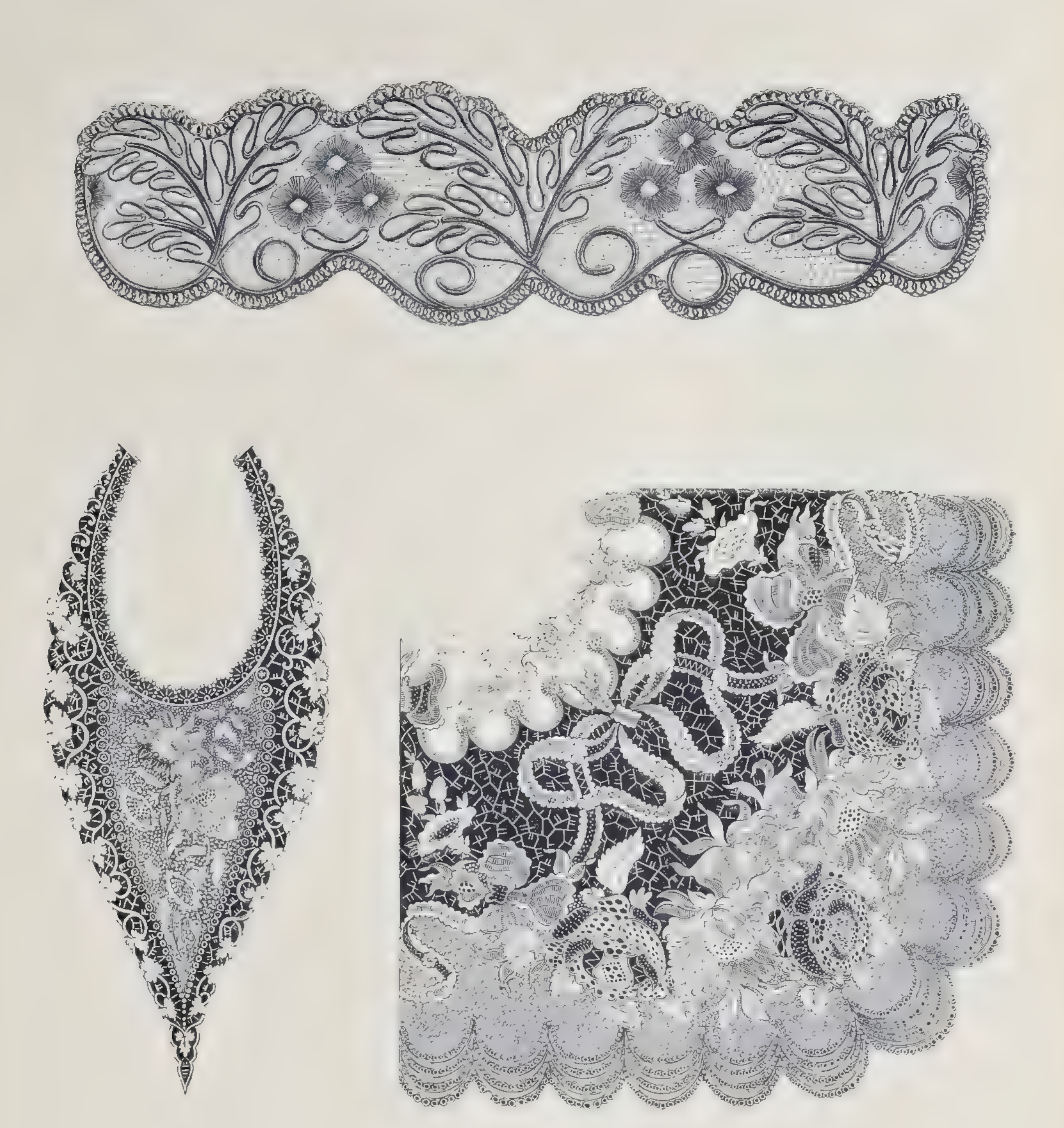
THE pattern is of unusual boldness, being in the tissue itself five feet in height, and twenty-seven inches in width: the designer, Professor Bötticher, of Berlin, has gone to the East for his elements, but he has treated them in a most graceful manner. The weaving is executed on a satin ground. This beautiful fabric, as well as the preceding one, was exhibited in 1851, and it was shown in various colours, and in more than one tint of some of the colours. It is the production of the establishment of Herr Garain.





NORWICH SHAWLS.

TWO beautiful examples of the famous Norwich Swawl manufacture, shown by Mr. Blakely at the Great Exhibition of 1851. In the upper example we see an adaptation of the conventional figures of the Indian designer combined with bouquets and festoons of British flowers. In the other, with the exception of the scroll, the treatment is entirely English, as are the bouquets and the hops.

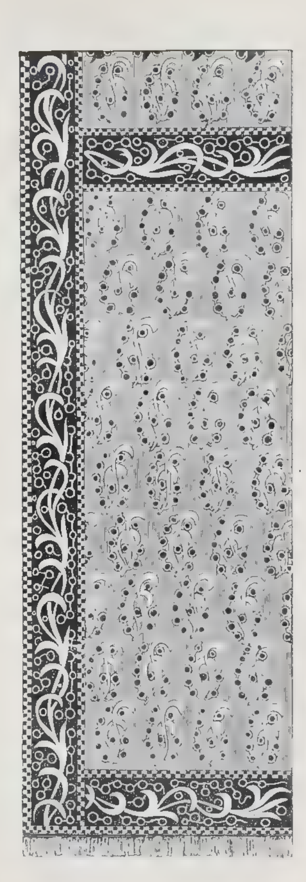


HAND AND MACHINE EMBROIDERY.

THE peculiarly formed piece of work below towards the left hand is a *canzou*, or lady's cape, exhibiting embroidery of the most beautifully elaborate design and the utmost delicacy of execution; the engraving side by side with it represents the corner of a French cambric handkerchief, which not only shows great taste and novelty in its design, but is remarkable as containing examples of every known stitch used in embroidery. The amount of time which these elaborate productions must have occupied seems incalculable. Both these articles were exhibited by Messrs. B. Salomons, of London, in 1851.

The figure above represents a piece of "embroidery trimming," exhibited at the same time by Messrs. Bennock, Twentyman & Co., also of London.



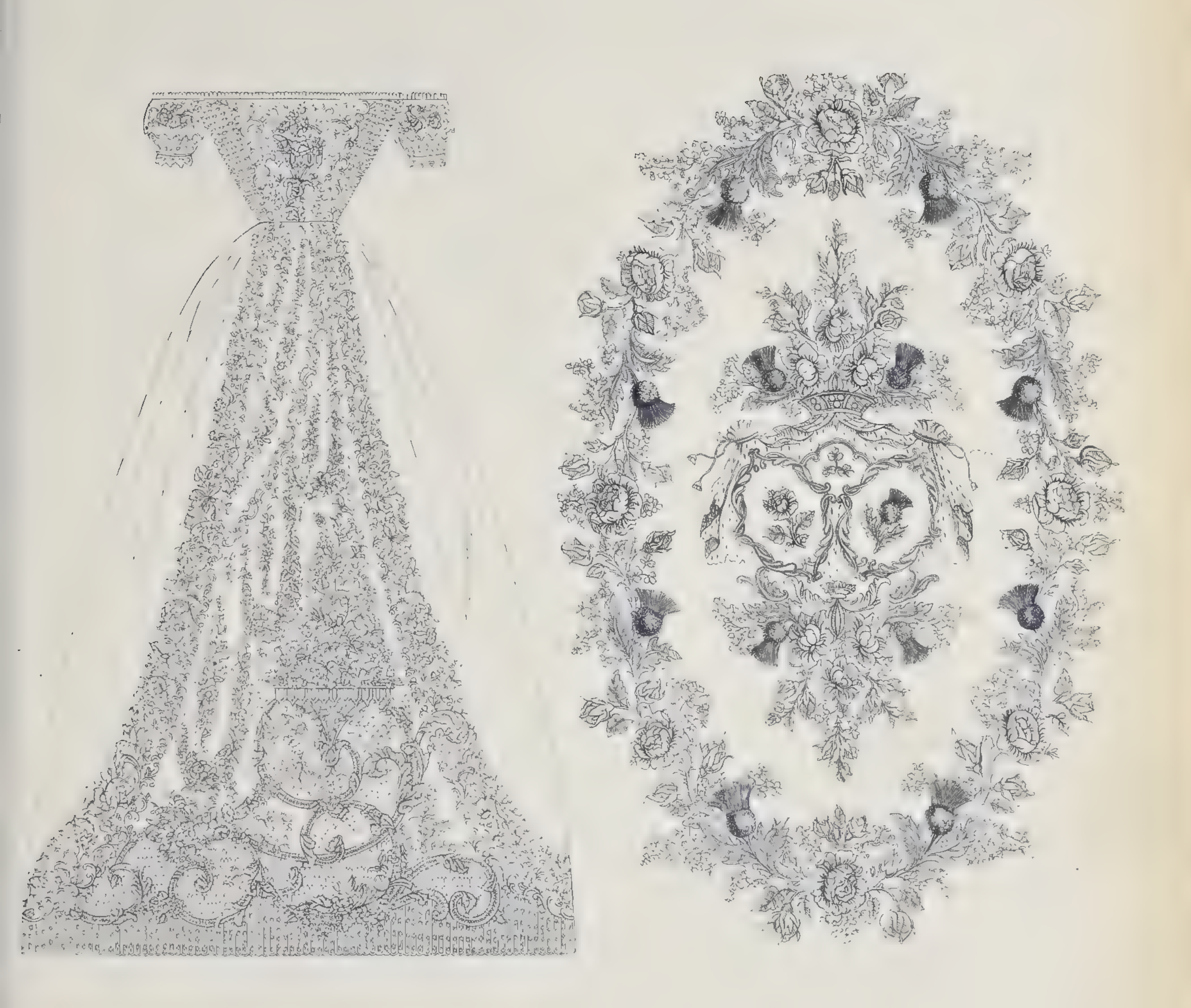


NORWICH CASHMERE SHAWL AND SCARF.

THE Shawl which supplies the larger of these illustrations has a special interest as having been the first Cashmere produced at Norwich in the Jacquard loom. It is superb in colour, of exquisite fineness, and the pattern is beautiful as it is elaborate, and deserves careful study. It was exhibited at the Great Exhibition by Messrs. Clabburn & Co.

A worthy companion but no rival, is the Cashmere Scarf shown at the same time by Mr. Blakely: the design contrasts curiously with that of the Shawl, being as remarkable for elegant simplicity as the former for elaborate beauty; it is a good example of great effect produced by simple elements artistically handled.

It was said that both these charming productions were purchased by Her Majesty the Queen.



SCOTCH NEEDLEWORK.

THE Child's Robe of richly embroidered muslin, of which the design is unusually elaborate, is the work of Messrs. S. & T. Brown, of Glasgow.

The other figure represents the central portion of a Cover for a cradle or bassinet, by Messrs. D. & J. Macdonald, of the same town: the material is cambric, but the groundwork has by a most ingenious handling of the needle been transformed into point.

Both these fine specimens of needlework were exhibited in 1851.

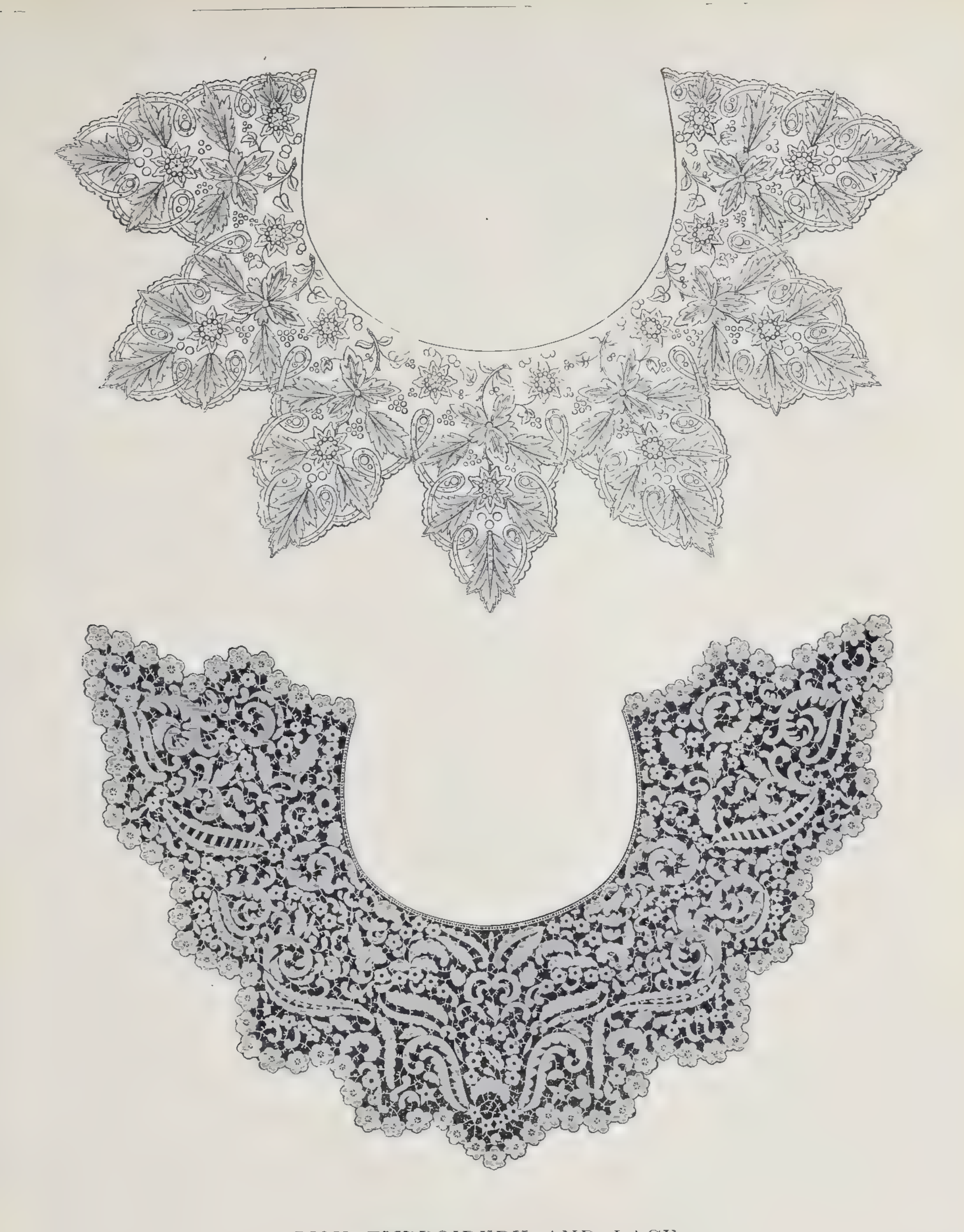




SCOTCH AND INDIAN WORK.

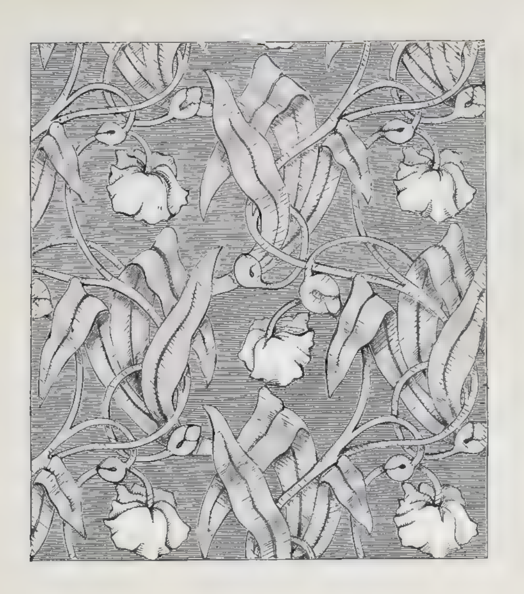
THE first and larger illustration is of one of the beautiful woven long Shawls of Paisley, and was exhibited in 1851 by Messrs. J. and A. Roxburgh of that town. The design is a very elaborate composition of floriate forms, the chief elements being the characteristic leaf-like forms of India, but relieved by many beautiful adaptations of natural flowers; it is very intricate, yet the artist has avoided confusion and produced charming relief by means of a few dark lines.

The accompanying example is of Indian origin; it is a Cashmere Couch Cover, the ornamental work being stitched on silk of a delicate light-blue tint. We have here the conventional forms alluded to above, but the whole of the central ornament, as well as those running from the ends to the central portion, are conceived and executed with all the geometric severity and perfect taste of the best ornamentation of the Mediæval period. The effect is perfect.



IRISH EMBROIDERY AND LACE.

THE upper of these two elegant examples is a specimen of embroidered work exhibited by Messrs. John Haldeon & Co., of Belfast, at the Dublin Exhibition of 1853, when the schools of design had just begun to produce the salutary effect on our Art-manufactures which has since progressed beyond expectation. Not many years since the patterns of lace and embroidery were as rude as basket-work, no particle of artistic knowledge entered into them. We have only to look at the two beautiful productions before us to see how much had been done even in 1853. The second example is by Messrs. Forrest, of Dublin, who have contributed many beautiful specimens of the like kind to our exhibitions. Work of this kind is in itself a delightful acquisition, all the world delights in lace and embroidery when not overloaded; but there is another interested connection therewith which is of enormous importance, the interest of our poor fellow-countrywomen. At the date above mentioned it was said that about half a million pair of hands were engaged in producing these beautiful gossamer works, and that nearly £100,000 per month was then paid in Ireland to women and girls employed in the trade. The great improvement in the art of design, by extending the use at home and the demand abroad of our lace and embroidery, thus becomes a great economical gift.





ENGLISH TEXTILES.

THE larger of the two engravings on this sheet presents one of the first fruits of the Spitalfields School of Design; the pattern of this piece, exhibited in 1851 by the committee of that institution, having been designed by Mr. Brown, first a pupil and then master of the school. The elements are familiar to the eye of every Englishman who loves the woods and hedgerows, but they are combined in a very graceful and effective manner. As in other cases, we have been compelled, in order to husband our space, to lay the engraving on its side.

The example given above is from a piece of elegant Furniture Damask by Messrs. McCrea, of Halifax; the pattern is very good.







ENGLISH AND FRENCH SHAWLS.

AN example of the beautiful imitations of Cashmere Shawls produced by Messrs. Swaizland, of Crayford, of which others will be found amongst our illustrations: the intricacy of the pattern is shown in the engraving, and the variety of colours exhibits equal elaboration. It was shown in 1851 by Messrs. Keith and Shoobridge, of London.

The two small engravings represent Shawls by MM. Verde de Lisle & Co. of Paris and Brussels, the "Compagnie des Indes," one of the most eminent manufacturers of shawls in Europe. It is lamentable how little can be done by wood engraving as regards the general effect of such brilliant productions as shawls; but our illustrations answer the main purpose in view, that of giving admirable examples in design. These two are very remarkable; offering modifications of the old conventional forms, which the Indians have made famous principally by their wondrous skill in the combination of colours, rendered most graceful and effective by geometric treatment, charming the artistic sense by its symmetry as well as by the elegant fancy shown in the details.



IRISH DAMASK.

THE table linen of Ireland is too celebrated to require introduction, it has long been one of the most beautiful of our national fabrics. The Table-cloth here illustrated was contributed by Mr. M. Andrews, of Belfast, under the title of the "Ardoyne Exhibition Pattern," to the Great Gathering in 1851. The design was the result of a competition, and the prize was won by Mr. J. Mackenzie, then a pupil in the School of Design of this metropolis of Northern Ireland. The designer has not confined himself to the flowers of his own country, or of the United Kingdom, but his types are well drawn and the composition is rich and effective, neither overloaded nor meagre.



SCOTCH DAMASK.

A SELECTION from a fine contribution of damask and diaper linen sent by Mr. Burrell, of Dunfermline, to the first Great Exhibition. The design is by Mr. Paton, who for many years contributed to raise the artistic character of the manufactures of that town: the way in which the leaves of the thistle are conventionalized so as to form thoroughly artistic borders show the true artist-hand; the other elements used in the ornamentation are the jewel of the Order of Saint George and the badges of the Orders of the Thistle and of St. Patrick.





ENGLISH TEXTILES.

THE larger example here given is that of a piece of Silk exhibited by Messrs. Redmayne & Co. of London in 1851. The pattern, composed of the national emblems, the rose, thistle, and shamrock, is well designed and very effective. Exigency of space has compelled us to place the engraving across the page, but the pattern should be regarded from the right-hand side.

The smaller figure represents a piece of Furniture Damask of the same period, by Mr. W. Brown, of Halifax; with a very appropriate and effective pattern.



SCOTCH DAMASK.

AN example of fine damask table-linen, produced by Messrs. Hunt and Son, of Dunfermline, for the use of Her Majesty the Queen at Balmoral, a representation of her Majesty's Highland home there furnishing the central subject, which is surrounded with illustrations connected with deer-stalking and other sports derived from the products of the locality. The leaves of the thistle are formed into a very effective scroll border. This beautiful Table-cloth was exhibited in 1851. It would be difficult to find a more exquisite example of this beautiful fabric, in the production of which Ireland and Scotland vie with each other and all the world.



SPITALFIELDS BROCADED SILKS.

A REMARKABLE example of weaving, exhibited by Messrs. Lewis and Allenby, of London, at the Great Exhibition, and manufactured for them by Messrs. Campbell, Harrison, and Lloyd, of Spitalfields. The pattern, when regarded as a whole, and in black only, appears simple in its arrangement; but a good effect is produced by repeating it in a reversed position, so that uniformity is produced in the alternate spaces between the patterns. When seen in the fabric, the appearance is marvellously different: the innumerable details glow in all the colours of the prism—no less than fifteen colours, or rather tints, entering into the composition of this elaborate work. Only those conversant with weaving with the Jacquard loom will fully understand what is meant by this brocade requiring nearly thirty thousand cards and ninety-six shuttles; each card which commands the warp threads during one passage of a shuttle is formed of a long and rather thick piece of pasteboard, and all the cards act in regular succession in the Jacquard machinery. The intricacy of the action of weaving with nearly a hundred shuttles to be taken up alternately and irregularly any one can appreciate.





IRISH DAMASK TABLE-CLOTH.

A BEAUTIFUL example of the products of Belfast, by Mr. M. Andrews, of Ardoyne, of whose productions we give other specimens of the same date, namely, previously to 1851. The charming design requires no explanation, it speaks to the eye at once, the types are beautifully drawn, and the whole design composed with great skill; but the specialities of the particular work have an interest of their own. This beautiful Table-cloth, with napkins to match, were made for presentation to the Earl of Clarendon, when or after he had held the high position of Lord-Lieutenant of Ireland, by the Royal Society for the Promotion and Improvement of the Growth of Flax in that country. In the centre of the cloth is the Star of the Order of the Garter, encircled by a garland of the rose, thistle, and shamrock, and above and below are his lordship's arms, surrounded by the Garter, with the jewel of Saint George suspended beneath.



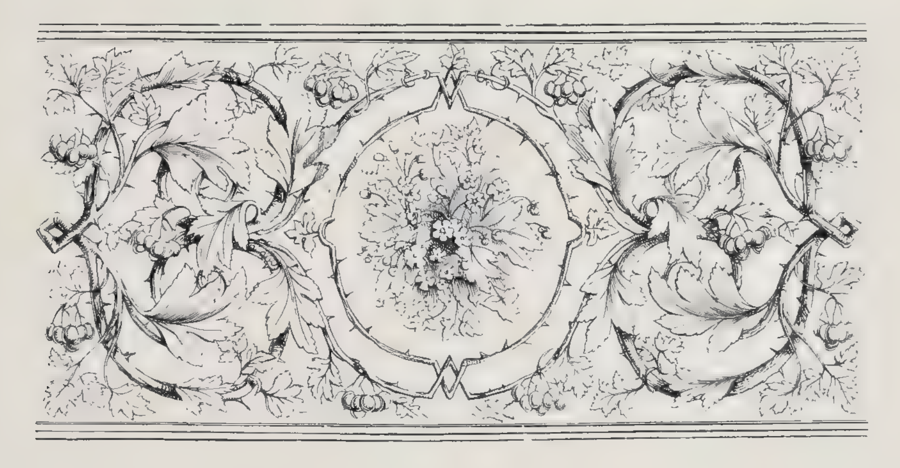


SPITALFIELDS AND BERLIN SILKS.

THE gay example of silk weaving towards the left hand represents one of the specimens contributed by Messrs. Stone and Kemp to the Great Exhibition; the foliage is peculiarly light and graceful, and, being executed in several colours, the effect is brilliant.

The other engraving represents a specimen of the production of Herr Gabian, of Berlin, a silk manufacturer of high reputation. The pattern is remarkable for boldness, and the material was probably intended for upholstery purposes in the royal palaces; its destination is marked by the presence of the Prussian black eagle.



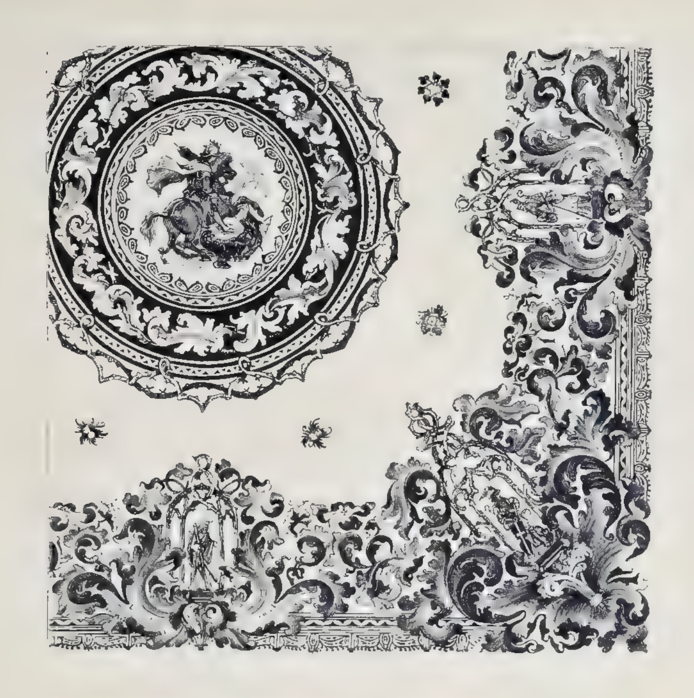


SCOTCH EMBROIDERY AND IRISH ORNAMENTAL LINEN.

TWO remarkable specimens of work, which for design are fitting companions, but presenting very different kinds of ornamentation. The upper figure represents an embroidered Muslin Dress by Messrs. Brown, Sharps & Co., of Paisley, who have called much artistic talent to their aid. The pattern of the dress before us is composed of natural flowers, not mere conventional forms; and the work, which appears rather small and crowded in the engraving, is in the actual production extremely bold, the pattern measuring about four feet by three, so that the elements of which it is composed are about ten times the size they are here represented.

The other example is that of a Linen Band, designed by Mr. M'Cloy, a pupil of the Belfast School of Design, and manufactured by Mr. M'Cracken, of the same place. The pattern presents much elegance and skill; it is derived from the hawthorn in its autumnal or ripe state, when the berries are of a deep red colour, and, the foliage being embossed in gold and the red berries on a blue ground, the effect is very brilliant. In the centre, however, the hawthorn is shown in bloom in its natural colours on a white ground.

Both these productions were contributed to the Great Exhibition.





SCOTCH AND IRISH DAMASK TABLE-LINEN.

THE first example of Damask Linen represented here is by Mr. Beveridge, the large producer of this and other textiles, of Dunfermline, by whom we give other excellent specimens. The design here is Gothic, which is not common in damask, and the treatment is bold and flat, as it should be for a cloth to cover the surface of a table. We need hardly say that the subject illustrated is the story of the Patron of England.

The second specimen is the work of Mr. John Heming, of Waringstown, near Belfast: the light and graceful composition of natural flowers and foliated scrolls won for the young artist, Mr. Hugh Blain, of the Belfast School of Design, the first prize for table-cloths offered by Lord Dufferin. This school has done much for ornamental manufactures, and is, we believe, doing more than ever under its present energetic director, Mr. Lindsay.

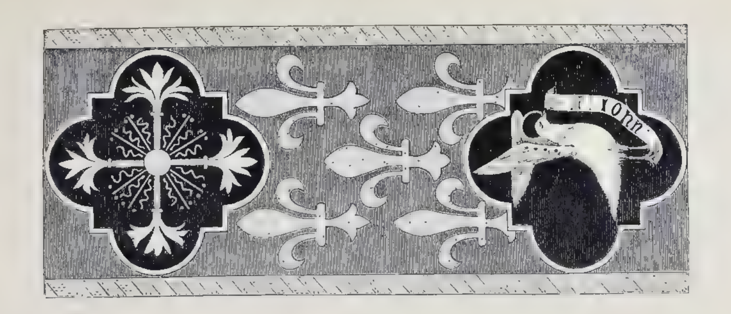




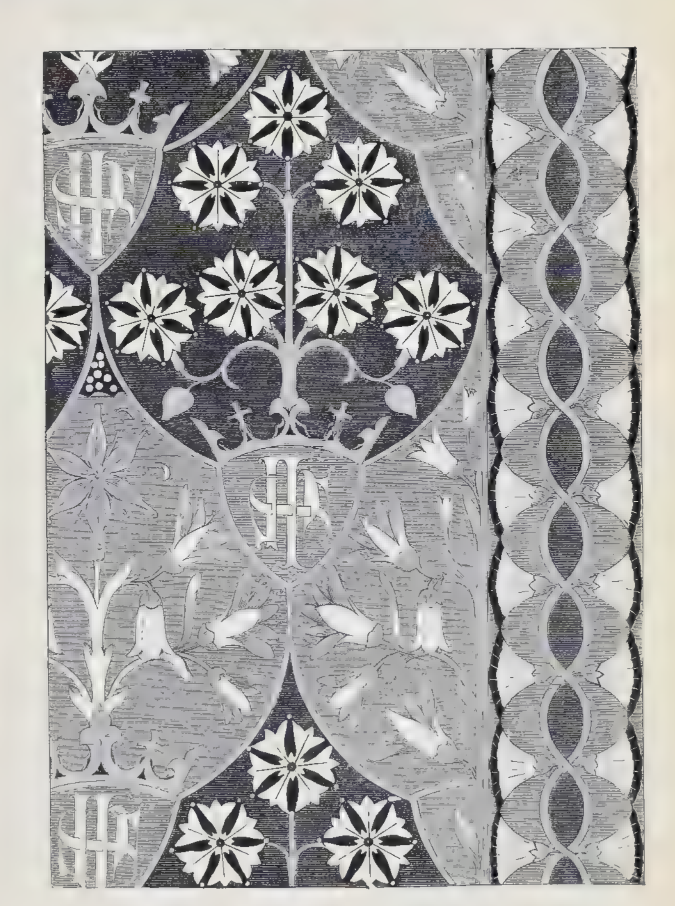
SCOTCH DAMASK TABLE-CLOTHS.

THE upper figure represents a Table-cloth manufactured by Mr. Berrell, of Dunfermline, for the United States market; in the centre is the portrait of Washington, surrounded by the emblems of American independence; the border, treated conventionally, is bold and effective.

The second Table-cloth here represented is by Mr. Beveridge, of the same town, who is said to employ about fifteen hundred persons in the manufacture of damask table-linen and table-covers. Dunfermline employs altogether probably sixteen thousand people in those branches of the textile trade—which is pursued with great spirit, clever artists being employed in designing, and receiving frequently, as we are told, a hundred pounds for the designs of a set of table-linen. Certainly it was no "prentice hand" that originated the beautiful piece of work before us; the knowledge of and feeling for the old classic types are evident, and their clever adaptation to the intended purpose equally so. The subject is the old but ever-charming subject of Cupid and Psyche, which is told in the central medallion and the groups in the border.







ENGLISH EMBROIDERY, Etc.

THE largest of the three illustrations on this page represents a portion of the orfraies of an Archbishop's Cape, designed for the Anglican Church by Messrs. Newton, Jones, and Willis, of Birmingham. The whole of the enrichments are worked by hand in gold and silk. Much of the ornamentation, produced in imitation of Mediæval work, consists of the mere arrangement of conventional forms in certain geometric modes, the effect of which is often admirable, but which does not demand much skill with the pencil. The arrangement of the seven flowers in the upper part of this example is of that class; not so the beautiful ornamentation of the two compartments below, where the artistic eye and touch are evident, both in the forms and the light and shade introduced. The border, too, is a happy adaptation of a graceful old ornament.

The small engraving, set crosswise for want of space, is part of an Altar Cloth, also worked in silk and gold, and is the production of the same firm.

The remaining illustration represents a piece of Tapestry of the sixteenth century at Hardwicke Hall, in Derbyshire. The ground silk is yellow, the pattern is outlined in crimson silk, and the flowers are worked in gold thread, and in some parts small gold scales overlapping each other. In this mansion are a crimson silk bed with the arms of Mary Stuart and the date 1599, and a black velvet bed partly embroidered by her own hand.





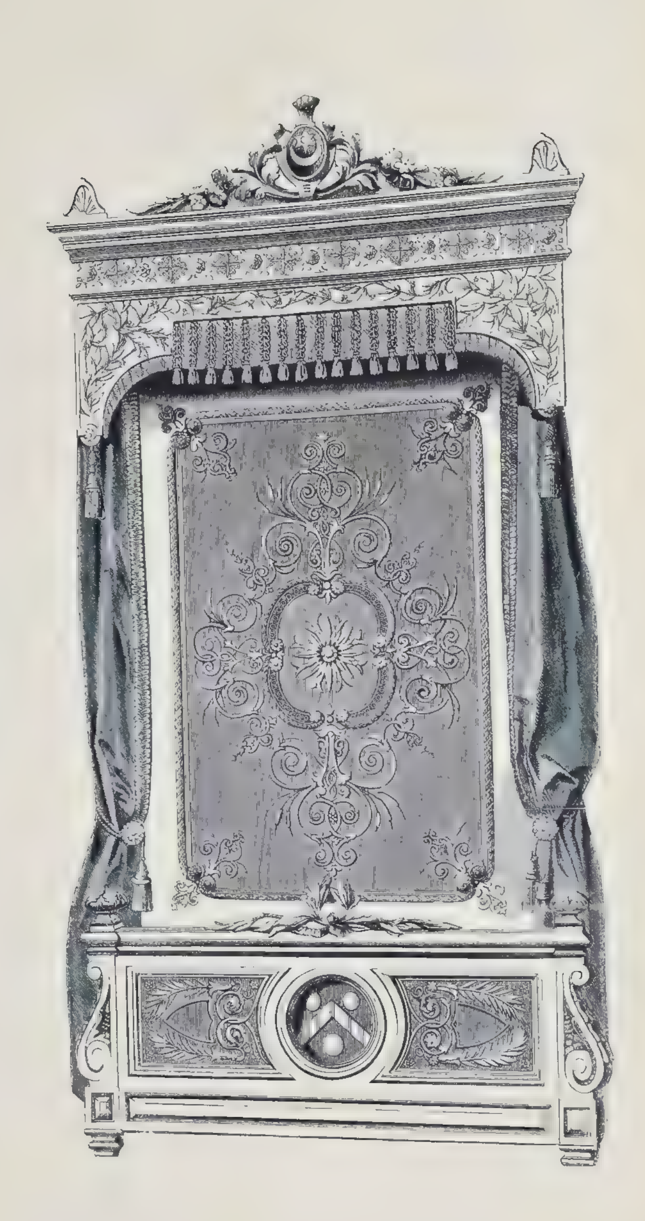
NORWICH SILK SHAWLS.

ABOVE is a square Norwich Shawl by Mr. E. T. Blakely, extremely rich and harmonious in colour, and skilfully designed; the spots in the centre are in gold.

The second engraving represents a portion of one of the beautiful fabrics for which Norwich is famous. It is a Silk Shawl of most elaborate pattern, with much sober harmony in the colouring. The part given here is the centre of the shawl—a very small portion of the whole, but it is sufficient to give an idea of the beauty of the work. This charming production was shown, with many others as beautiful, at the first Great Exhibition.







ENGLISH EMBROIDERY WORK.

EXCELLENT examples, the production of Mr. Radley, of London and, we believe, also of Paris. The large engraving represents an Arabian Bedstead, which attracted much attention at the 1862 Exhibition; the others are portions of panels for the decoration of state rooms. A glance at the above representations will show how carefully and skilfully the designs have been drawn, and we have only to add that the arrangement of colours and the execution of the embroidery are quite worthy of the designs, and that these embroidery works are unsurpassed of their kind.



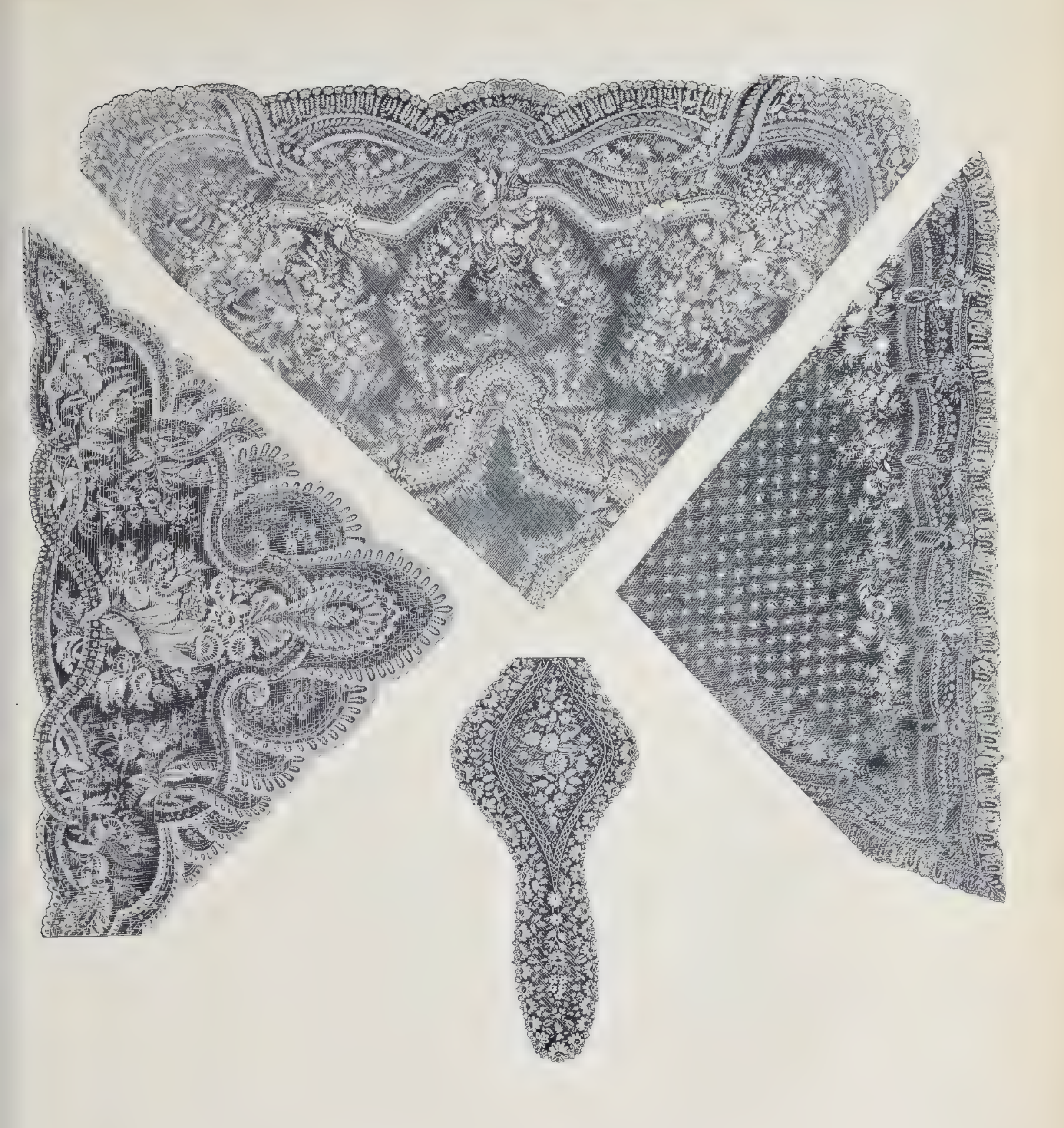


ENGLISH AND IRISH FURNITURE STUFFS.

Of the examples given above, the three engravings which head this page represent Silk Furniture Hangings by Messrs. Keith & Co., of London, and present designs of great merit and purity; these were manufactured specially in or about the year 1862 for Messrs. Hindley and Sons, Gillows, and Johnson and Jeanes.

The two smaller engravings which occupy the central position below are from the beautiful fabric called Tabbinet, manufactured by Messrs. Pim Brothers, of Dublin, of whose productions we shall have to speak elsewhere.

Equally remarkable with the preceding are the two remaining examples, which are from Damask Furniture Silks by Messrs. Walters and Sons, of London, who manufacture goods of this kind of the highest quality, and which compete successfully with the best productions of any country in the world. The patterns generally worked by Messrs. Walters and Sons, and all first-class producers of such fabrics, are conspicuous for simplicity and harmony—that is to say, for Art; the specimens here given are admirable instances.



FRENCH AND ENGLISH LACE.

THREE fine examples of Lace, the manufacture of Messrs. Ferguson and Son, of Paris and Amiens, and exhibited by Messrs. John Gower and Sons, of London. Messrs. Ferguson's productions are conspicuous for grace and elegance of design, as well as excellence of manufacture; they are made on the "pusher" machine, and the figures are afterwards embroidered and finished by hand. The article at the head of the page is a square shawl in white; towards the left hand is a half-shawl in lama hair; and opposite to that an oblong shawl in silk.

The exquisite little example which completes the page is a *Coiffure*, or lace for the head, in Honiton guipure, by Messrs. Hayward, of London, who are said to give employment to two thousand women and children in Devonshire and Buckinghamshire. Honiton lace has acquired a high reputation abroad, which has materially increased since the marked improvement that has taken place in the designs for this beautiful fabric.









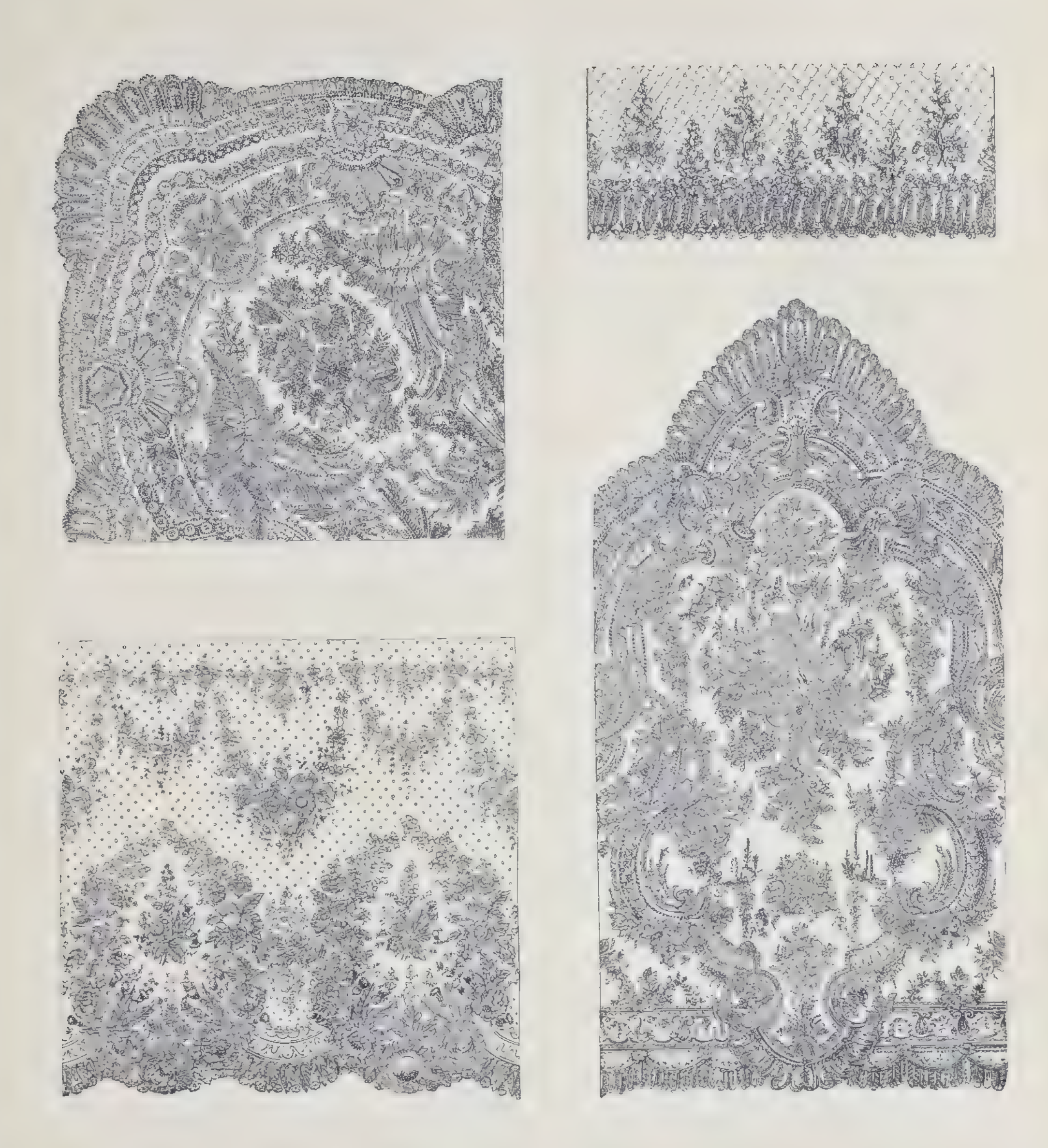
ENGLISH FURNITURE SILKS.

FOUR examples of the productions of Messrs. Daniel Walters and Sons, of London, Braintree, and Notley, large manufacturers of silk and mixed fabrics for upholstery and decorative purposes. These specimens show how much taste is brought to bear on the manufacture. No. 1 is a composition of the hibiscus flower and umbrosa leaf, woven in three colours in brocatelle. The hibiscus, or at least two varieties of it, are amongst the most beautiful of flowering shrubs; one of these varieties bears a brilliant crimson flower three inches in diameter, and the other a buff-coloured flower with a dark centre, equally large. The hibiscus is much used in Paris as a decorative plant, though not common in London; every designer should be acquainted with it. The second design is a conventional one in the Louis XVI. style; it is a silk damask woven in two shades of one colour. No. 3 is from the cencier flower, woven in all silk of two colours, but in such a manner as to produce the effect of three. Lastly, we have a very effective arrangement of the horse-chestnut, all silk, in three colours; reduced as the leaf is here, it somewhat resembles that of the Virginia creeper, which is much used by the French, who call it *la vigne folle;* we have seen it beautifully rendered in chased gold bracelets, &c. Its spring and autumnal tints also present exquisite colouring.



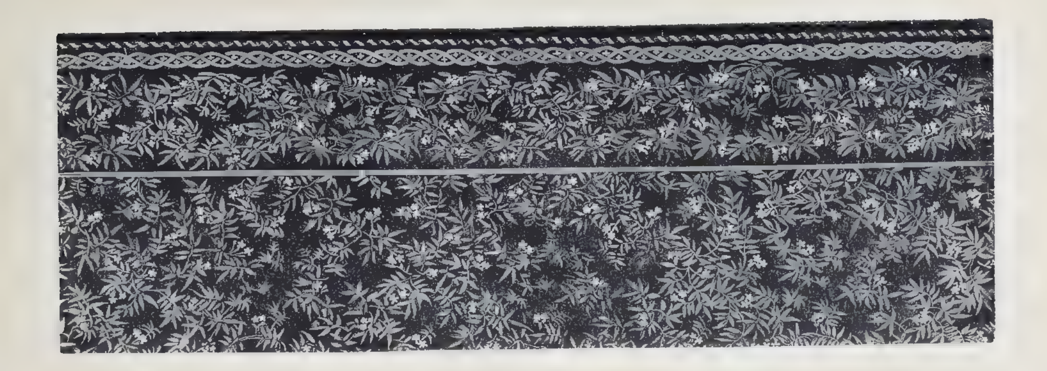
HONITON LACE.

A MAGNIFICENT example of this beautiful English lace, a Bridal Veil exhibited by Messrs. Northcote, of London, in 1862. The design is effective, and the composition exceedingly elegant; the lines flow easily and gracefully, and the flowers seem to spring naturally from masses of ornament, bases which seem to be essential to the arrangement of patterns for lace, though it is difficult to say why such a peculiarity should be essential. Honiton lace has long been famous, and it is to be hoped that the demand for it has increased of late in proportion to the great improvement which has been made in the designs for it, for the Honiton lace manufacture is a matter of no small importance, furnishing employment to tens of thousands of women. How many Devonshire lasses must have been employed, and how long, on this superb veil!



FRENCH LACE.

EXAMPLES of lace manufactured by an eminent firm, Messrs. Dognin & Co., of Paris and Lyons. No description is necessary here, for every student in design will examine these admirable patterns with an eager eye: the designs are beautifully various, but they all exhibit that continuity, harmony, and completeness which can only be attained by means of a thorough acquaintance with the principles of ornamentation, great observation, and much practice. In all the designs before us there is that subtle quality which no one can define and yet which almost every one can appreciate, which in all departments of Art is known as "style." It is not the mere result of cleverness, but of a well-defined intention, founded on study and great practice, effectively carried out.



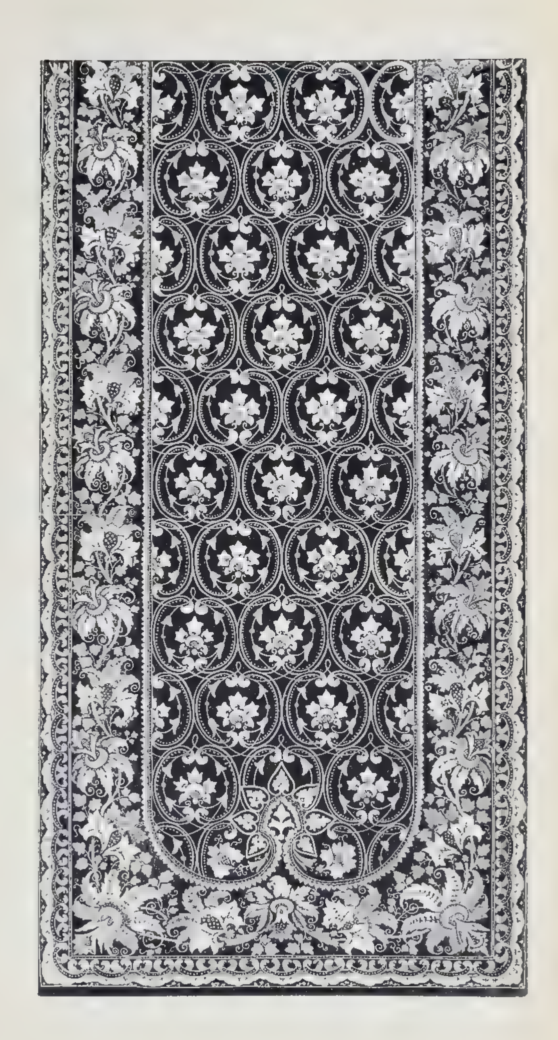


SCOTCH DAMASK AND ENGLISH CARPETS.

BELOW is an engraving representing a Tablecloth from the famous manufactory of Messrs. Birrell Brothers, of Dunfermline, which was made for Mr. Wemys, M.P. for Fifeshire. The arms are those of the families of Wemys and Erskine quartered, and the ornament introduced in the corners is the emblem of Macduff, Thane of Fife, from whom Mr. Wemys is, we believe, lineally descended. The design is worthy of the artist, Mr. J. N. Paton, to whom the trade of Dunfermline owes a deep debt of gratitude.

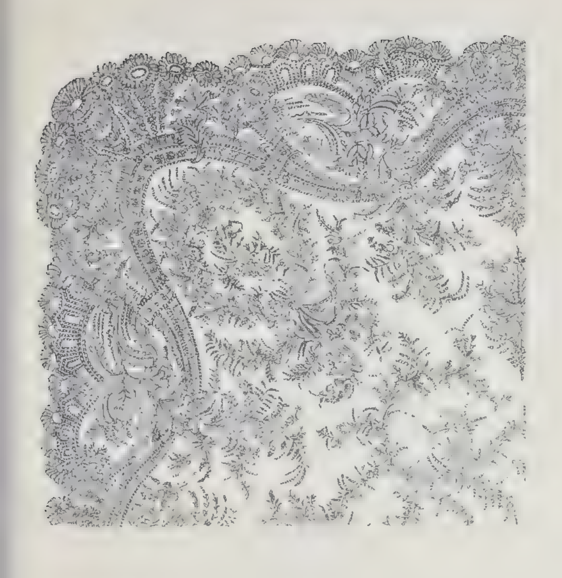
The upper part of the page is occupied by an example of ordinary Brussels Carpet, by Messrs. Jackson and Graham, with a very simple, graceful pattern carried out in the border as well as on the ground of the carpet; patterns of this graceful nature never weary the eye.

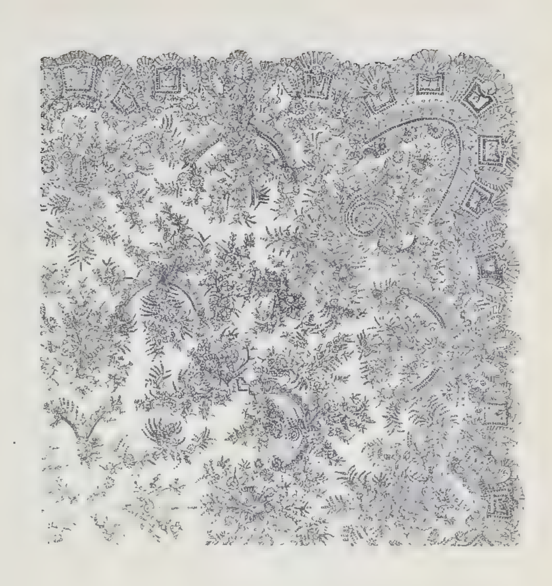




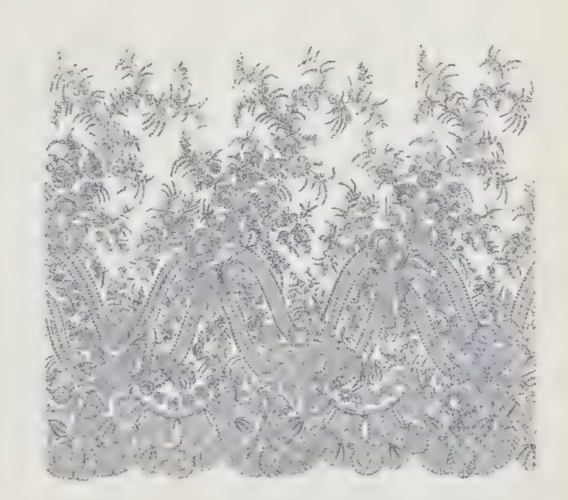
NOTTINGHAM LACE CURTAINS.

AMONGST the most curious machines employed in the production of textile fabrics are those which produce lace of various kinds. The enormous amount of labour required to produce a large piece of hand-made lace of a complicated design, and consequently its high price, naturally turned the thoughts of clever machinists to the production of something as much like it as possible by means of the loom, which already performed wonders in silk and other textile manufactures. Previous to 1851 this application of the Jacquard principle was not at all complete, but a little later this was accomplished. There are several kinds of lace-making machines, which we shall have to speak of elsewhere. The Curtains before us are examples of pure machine lace—they come complete from the machine and require no touch of the hand; how admirably the work is done may be seen in almost every house in the kingdom. The facility which the Jacquard gives has led to far too much decoration, and some curtains are literally overladen with flowers, scrolls, and ornaments of every kind; but of late a great improvement has taken place in the designs, and many of these curtains are now remarkably beautiful. The two examples here given are the production of Messrs. Haymann and Alexander, of Nottingham, from the designs of Mr. S. W. Oscroft, when a pupil of the School of Design of that town.









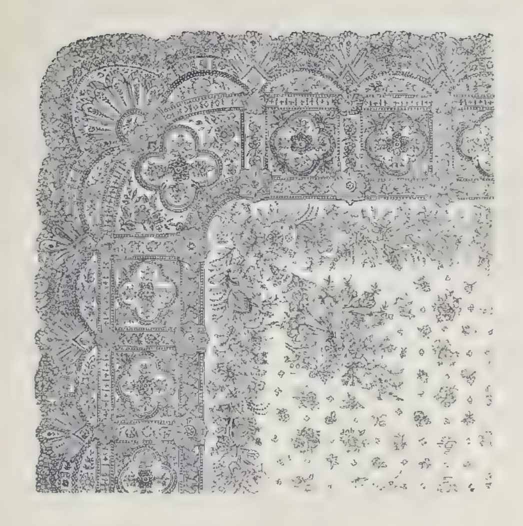
NOTTINGHAM LACE.

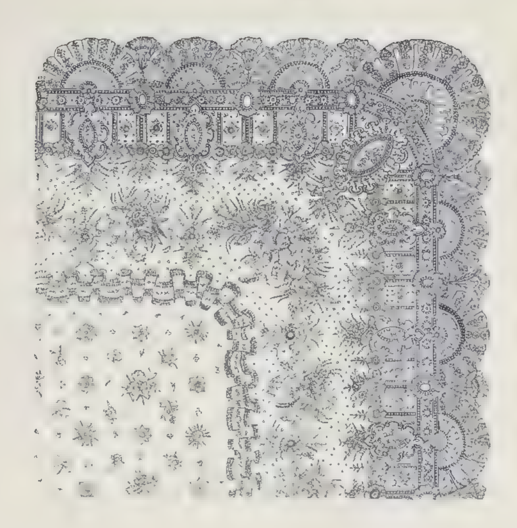
SPECIMENS of Lace by Messrs. Reckless and Hickling, of Nottingham. They are produced with the aid of a machine called the "pusher," but they are not finished on the machine, which may be said simply to sketch them; this is the method by which the shawls, flounces, and fancy articles of a superior character are produced; each article being made in one piece, and then embroidered, or rather the embroidery finished by hand. There is no "*appliqué*," or lace-work proper of any kind. The examples here produced are most pleasing illustrations of the progress that had been made in the designs for such articles by the year 1862, when these were exhibited, and that progress has become general since. These four are admirable, and it is stated that Messrs. Reckless and Hickling's designers are English.



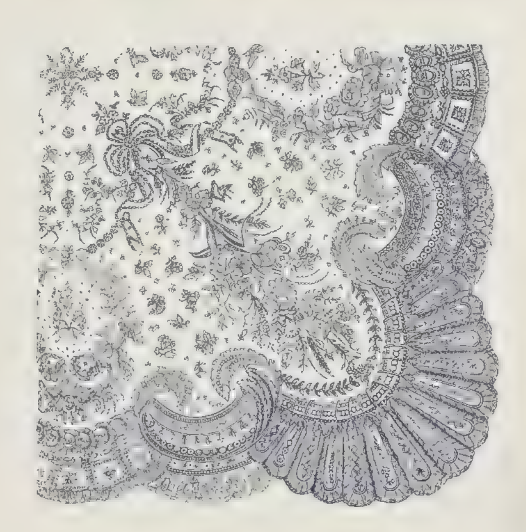
PAISLEY SHAWL.

A SUPERB example of the manufacture of Paisley, and of the perfection of the application of the Jacquard principle. The fineness of this specimen can only be expressed by the fact that there are seven hundred and seventy shoots of weft, that is to say, as many flights of the shuttle to every inch, and that the pattern required no less than thirty thousand *cards*—or rather, we should say, the half-pattern, for the halves of the shawl being facsimiles of each other, the *cards*, of course, operate twice over, first in one direction and then in the other; so that there are sixty thousand passages of a card in the machine. We need say little about the design, it speaks for itself; it is an exquisite modification of the famous Cashmere style.









NOTTINGHAM LACE SHAWLS.

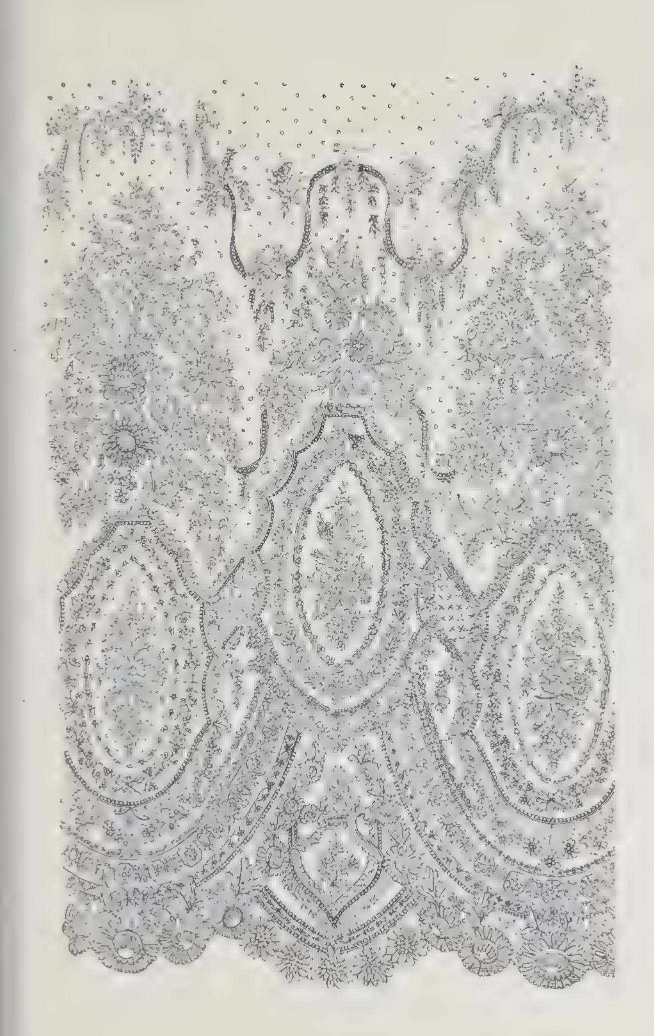
WE have already given some beautiful examples of the "pusher" machine lace of Nottingham, and we may here add to the observations already made, that although the fabrics in question very nearly resemble, both in the net which forms the groundwork and the decoration, the exquisite lace of Chantilly and Bayeux, there is no lace-work whatever, properly so called; the productions are fancy machine net-work, finished by hand embroidery. The examples given here are by Mr. W. Vickers, one of the largest makers. When we see such charming designs as those before us, and consider that these half-machine-made fabrics cost almost nothing in comparison with the hand-made lace they imitate more or less successfully, we must admit the production to be one of the grand triumphs of modern industry.

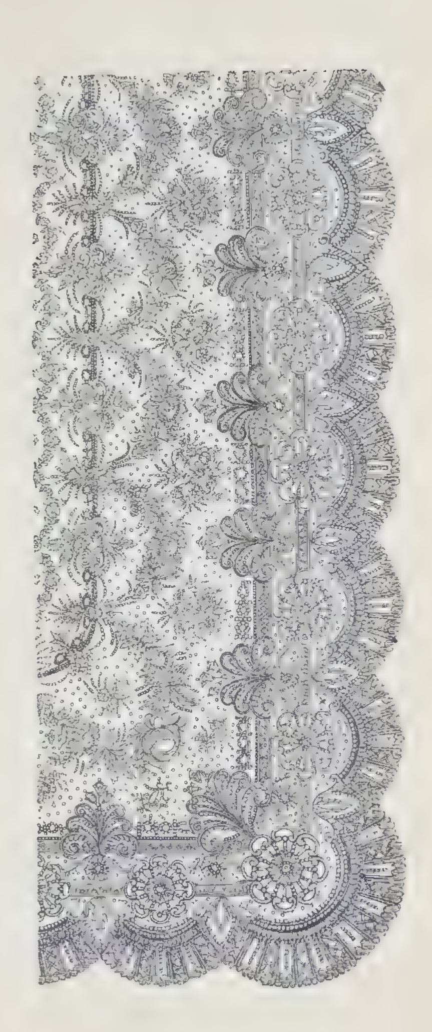




NOTTINGHAM CURTAINS.

THE two examples here given are the production of a firm which for many years has exhibited great activity, that of Messrs. Copestake, Moore, Crompton & Co., of Nottingham and London. The lace machines have undergone a complete revolution during a few years, and in 1862, when these fine examples were exhibited, it was stated that improvements had then recently been made in the production of the fabric which gave it these important advantages, namely, greater durability, more transparency in the ground of the fabric, and additional clearness and sharpness in the pattern. The improvements have since been further carried out, and the beauty and variety of the designs which are now produced in these machine-made curtains are very remarkable, while, however large the size, the curtains are produced in one piece without a seam. The two patterns here given, essentially different in character, are well deserving of study, and show how much Art the manufacturers have called to their aid.



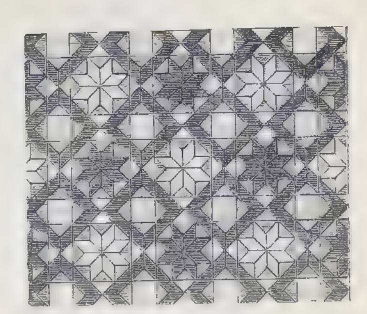


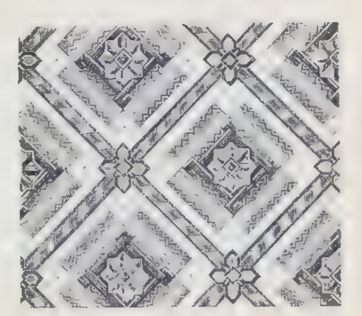
ENGLISH PILLOW AND MACHINE LACE.

THE larger of these engravings represents a black Buckinghamshire Lace Flounce, thirty-eight inches in depth, and of the finest workmanship, comparing favourably with the lace of Caen and Chantilly. It was not till some years after the first Great Exhibition that such large specimens of fine lace were attempted in Buckinghamshire; but the movement in the direction of Art-manufactures, the extension of schools of design, and perhaps some other circumstances, gave an impetus to the industry in that county, where the fabric also at the same time underwent improvement like the designs. Of the pattern of the admirable specimen before us we need say nothing, its beauty is evident. This flounce was produced by Mr. E. Godfroy, of Buckingham, and exhibited by Messrs. Debenham, Son, and Freebody.

The other illustration is that of a Black Lace Shawl, produced on the "pusher" machine, and finished by hand, and is the production of Mr. W. Vickers, of Nottingham, of whose excellent lace we have given other examples. Here, too, we have an elaborate and carefully-studied design, of another character, and of great beauty.







SCOTCH DAMASK TABLE-CLOTH, AND FLOOR-CLOTHS.

THE beautiful example of Damask Table Linen engraved above is another specimen, in addition to those we have already given, of the productions of Messrs. Birrell Brothers, of Dunfermline, from designs by Mr. J. N. Paton, whose pencil has done much for the Scotch damask manufacture. The design before us is, perhaps, one of his happiest efforts. The table-cloths were made for the Marquis of Breadalbane, the arms in the centre being those of the families of Campbell and Stewart quartered with the galley of Lorne. The insignia are those of the orders of the Thistle of Scotland, and of the Black Eagle of Prussia.

We make room here also for two good floor-cloth patterns by Messrs. Nairn & Co., of Kirkaldy; one is a simple representation of parquetry floor, the other is based on the same original with slight additions.



HONITON LACE DRESS.

A PORTION of a Honiton Lace Dress, true hand-made lace of the finest texture, exhibited by Messrs. Howell and James, of London. The design is most elaborate, the whole of the ground being covered, yet there is sufficient variety and relief to prevent any appearance of confusion. The border is composed of a scroll and floral chain supporting a cornucopia with bouquet of tulips, roses, escallonia, and other flowers; a chaste medallion occupies what is nearly the middle of our engraving, containing a bouquet of the rose, thistle, and shamrock, having beneath it a diaper of oak leaves, and around it a wreath composed of roses, amaryllis, tulips, and coreopsis. The grand bouquet, which rises high above the medallion, is composed of œnothera, campanula, mysotis, phlox, roses, nuttalia, and other flowers. On the upper part of the dress is a wreath of laburnum, oxalis, and calendula. This is certainly one of the finest examples of modern hand-lace produced in this country. The amount of labour which it entailed must have been enormous.











ENGLISH AND IRISH DAMASK, TABBINET, Etc.

WE collect here a variety of specimens of fabrics all claiming attention for their designs.

That which occupies the upper place is another example of Messrs. Keith's excellent Silk Damask Hangings, of which more will be found in these pages.

Beneath the preceding is an example of Silk Damask of good and graceful design, exhibited by Messrs. Jackson and Graham, of London.

Below are two examples of Tabbinets and one of Silk Damask, by Messrs. William Fry & Co., of Dublin, the famous manufacturers of poplins.



AUSTRIAN AND ENGLISH LACE, Etc.

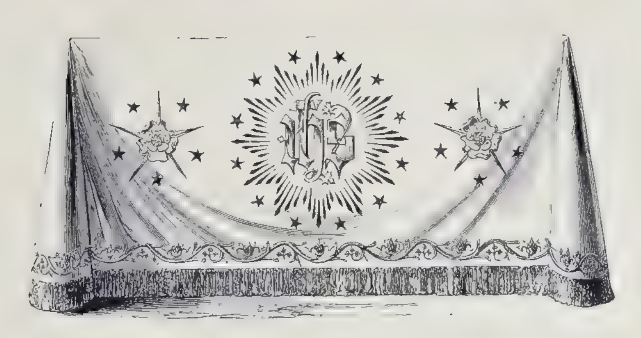
THE engraving which occupies the upper place here represents a portion of a Window Curtain manufactured by Herr Faber, of Vienna, from the design of Herr Frederick von Tischbach, an eminent artist, who has done much for the manufactures of Vienna. All is good, but the inner border is an exquisite piece of work.

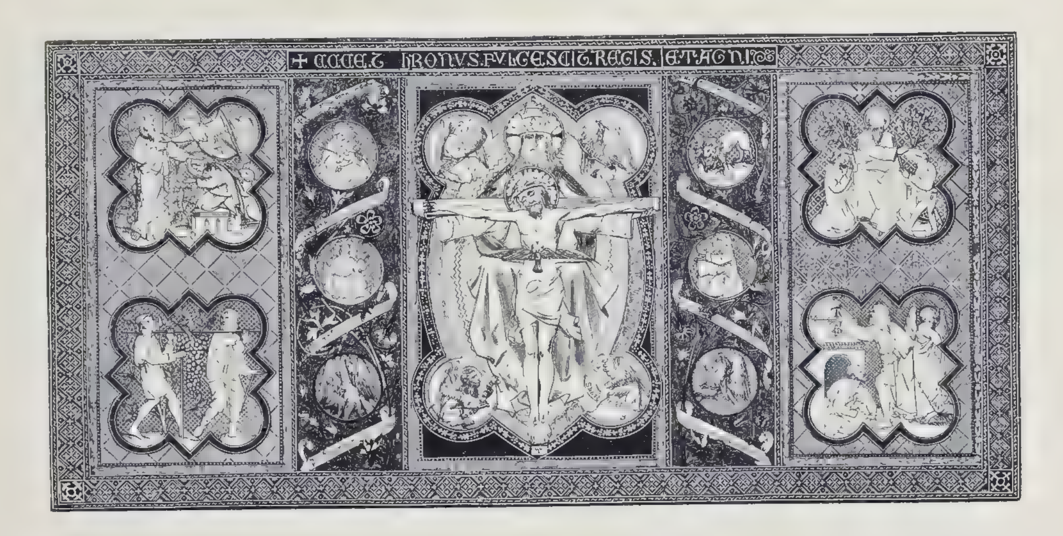
The large figure represents a Tunic Flounce in Honiton guipure lace, exhibited by Messrs. Hayward, of London: the relief obtained by the contrast between the guipure and the lace pattern is highly effective.

Of the two smaller examples by the side of the preceding, the upper and larger is a portion of an exceedingly delicate Shawl in what is called "pusher bobbin network," that is to say, partly woven and finished by hand, by Mr. W. Vickers, of Nottingham.

The last is a portion of a Curtain entirely made in the machine, by Messrs. S. Wills & Co., of the same town: the design is not only pleasing but well-considered, and consequently not spoiled when hanging in folds.







ENGLISH AND AUSTRIAN ECCLESIASTICAL FABRICS.

THE first of these engravings represents a linen Communion Table Cloth, by Mr. Gilbert French, of Bolton, who was one of the first to improve the designs of fabrics of various kinds in Mediæval style, and especially those applied to church purposes.

The second figure is that of a crimson velvet Altar-cloth, richly embroidered in gold: the flowing border pattern consists of trefoils and Gothic pine apples alternating with each other. The design was by Mr. W. Harry Rogers, and the cloth was produced by Mr. T. Harrison, of London. This and the preceding date back to 1851.

Below we have the representation of a superb Altar-cloth, embroidered with the needle, shown by Herren Giani, of Vienna, famous producers of ecclesiastical vestments, &c., who exhibited a mass of beautiful productions at the Paris Exhibition in 1867, this being amongst them.





ENGLISH AND FRENCH LACE AND EMBROIDERY.

THE first figure is that of a Curtain produced specially for the International Exhibition of 1862, by Messrs. Thomas Adams & Co., of Nottingham; it is two yards wide and four yards and a half long. In the width of it there are 2,460 threads, each lifted and dropped as required, independently, by means of the Jacquard machine. In this example not one of the figures in the pattern is repeated either in the breadth or the length, and, consequently, it required 11,508 cards to produce it. An important point in the manufacture of this and other curtains of the same class is that all the threads used in the work are so arranged that when not entering into the pattern they form the net-work, so that there are no superfluous ends to be cut off.

The second engraving represents a Window Curtain, or rather Blind, embroidered on net, by the firm of Buffier Leutner, of Tarare, near Lyons, France. The design represents the arms of the city of Paris, encompassed by emblems and ornaments. It may be mentioned that these curtains or *stores* are narrow, and are hung on the halves of French windows, which open like doors, so that they are not in folds or festooned, but show all the pattern admirably.

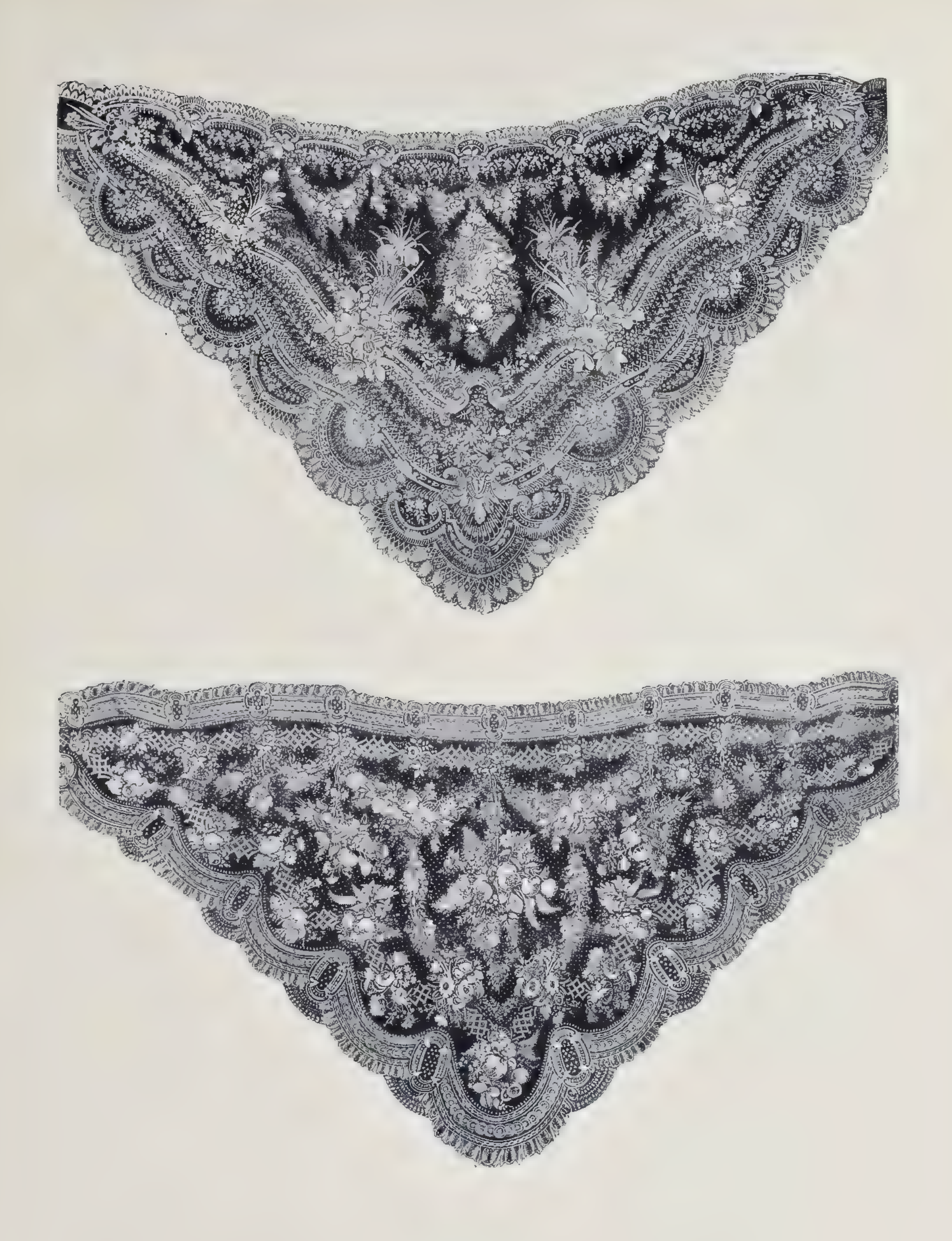






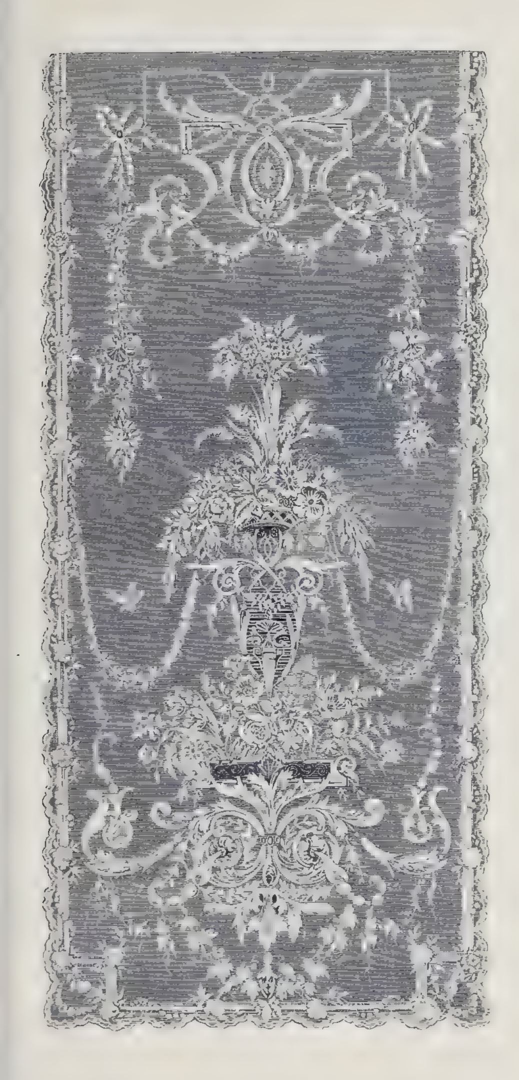
FRENCH TAPESTRY.

EXAMPLES of the productions of M. Mourceau, of Paris, a large manufacturer of tapestry, principally for upholstery purposes: the large central piece is a Portière, or Door Curtain, decorated in that light, fanciful style which carried all before it in the time of the latter Louis, but which scarcely aimed at anything beyond prettiness, and depended principally on colour for its effects. The other engravings represent borders of curtains, and present two excellent examples of arabesques in different styles, capitally designed. M. Mourceau's productions are beautifully executed, and have won him all the honours.



BRUSSELS LACE.

BRUSSELS has long had a high reputation for its lace, which is peculiarly elegant and gossamer in character, and which had always the benefit of artistic design; but it is rare to find specimens so remarkable in this last particular as those before us, designed, we should say, by the same hand, but presenting marked variety. The four bouquets springing from the inner border of the upper example are exquisitely graceful, and every portion of the work is drawn and worked with marvellous taste and skill. These beautiful pieces were produced for the Compagnie des Indes of Paris and Brussels, under the direction of M. Verde Delisle.





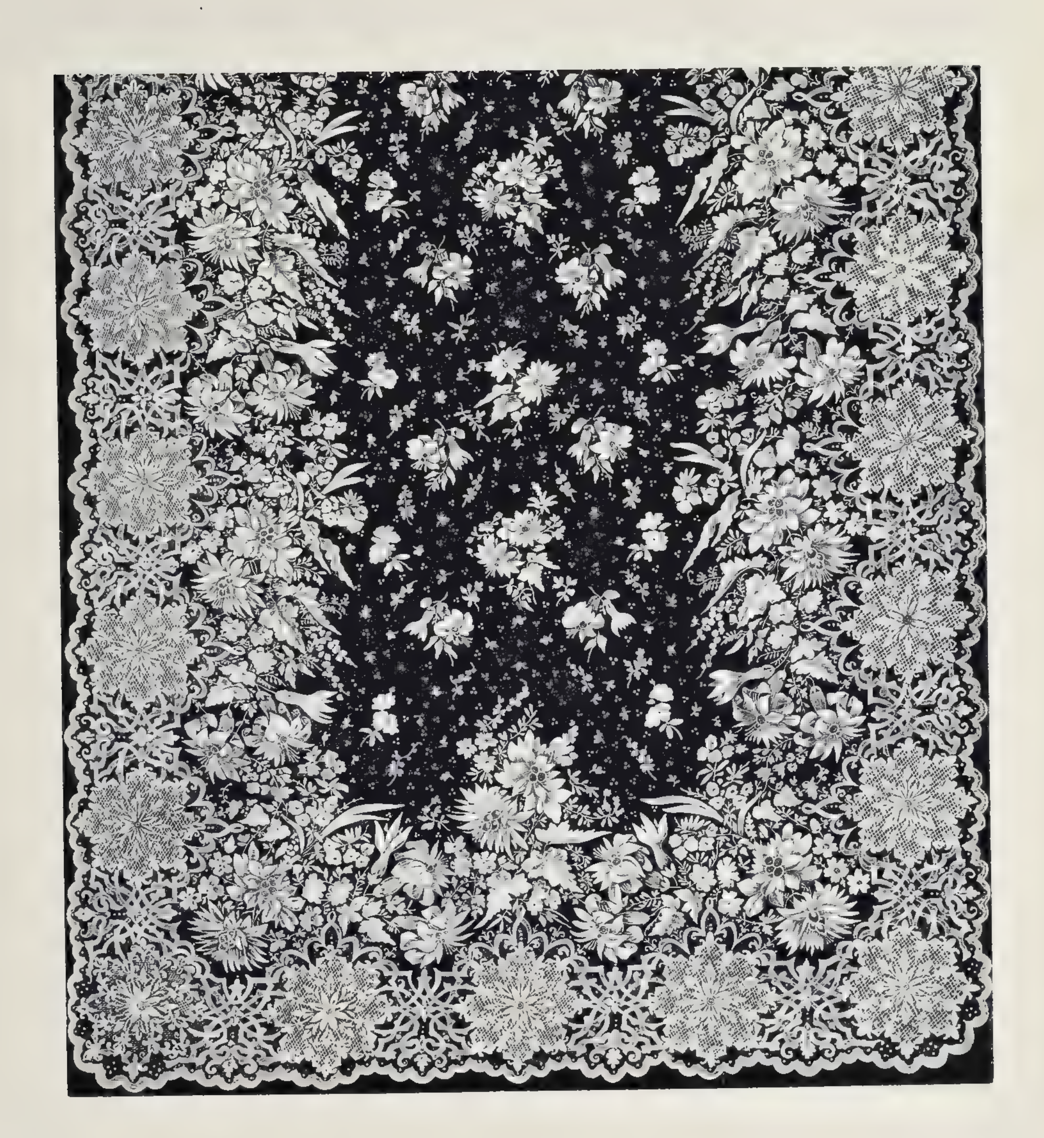
FRENCH CURTAINS.

TWO specimens of Curtains of excellent workmanship, exhibited by the *Maison Blanc* of Paris—so called from the fact of the speciality of the establishment being linen, cotton, and other white goods. M. Leopold Meunier, the director, has achieved a reputation for great judgment in the production of artistic goods of this kind, and the two curtains engraved here are selected from a considerable number equally good. The designs are very graceful, and it will be perceived that no portion of the pattern is repeated in the length, though the whole design is repeated in the example towards the left hand, and most of it in the other case also, in the width. As we have elsewhere observed, French curtains are not large and are intended to hang flat, so there is not the same difficulty about design and execution as in the case of the long and broad fabrics of Nottingham and other looms.



DRESDEN DAMASK.

IRELAND and Scotland are famous for their linen damasks, but they are not without rivals well worthy of them. The splendid Table-cloth here engraved is the production of a large establishment—that of Herr Joseph Meyer, of Gross-Schönau and Dresden, who manufactures all classes of damask on a large scale. Herr Meyer, like our own manufacturers of the same class of fabrics, obtains the aid of eminent artists; the rich and elegant pattern here given is from the design of Herr Krumbholz, professor of ornament and design in the Polytechnic School of Dresden. As a rule figure subjects are not to be recommended for damask designs, but the central medallion here is very beautiful.



SWISS TAMBOUR WORK.

ONE of the most beautiful examples of this kind of work we have ever seen. The engraving represents a portion of a Curtain manufactured by Messrs. Rauch and Schaeffer, of Saint Gall, and exhibited in 1867, when it was purchased (with others) by Messrs. Swan and Edgar, whose good taste is well known. The design is certainly admirable, full yet perfectly distinct, the artistic touch evident throughout. The border, composed of magnificent conventional rosettes, or floral stars, connected with each other by geometrical band-work in the old Italian style, is remarkably beautiful, and the botanical character of all the flowers employed in the other portions of the work are carefully preserved; in short, the whole work is a gem of its kind.



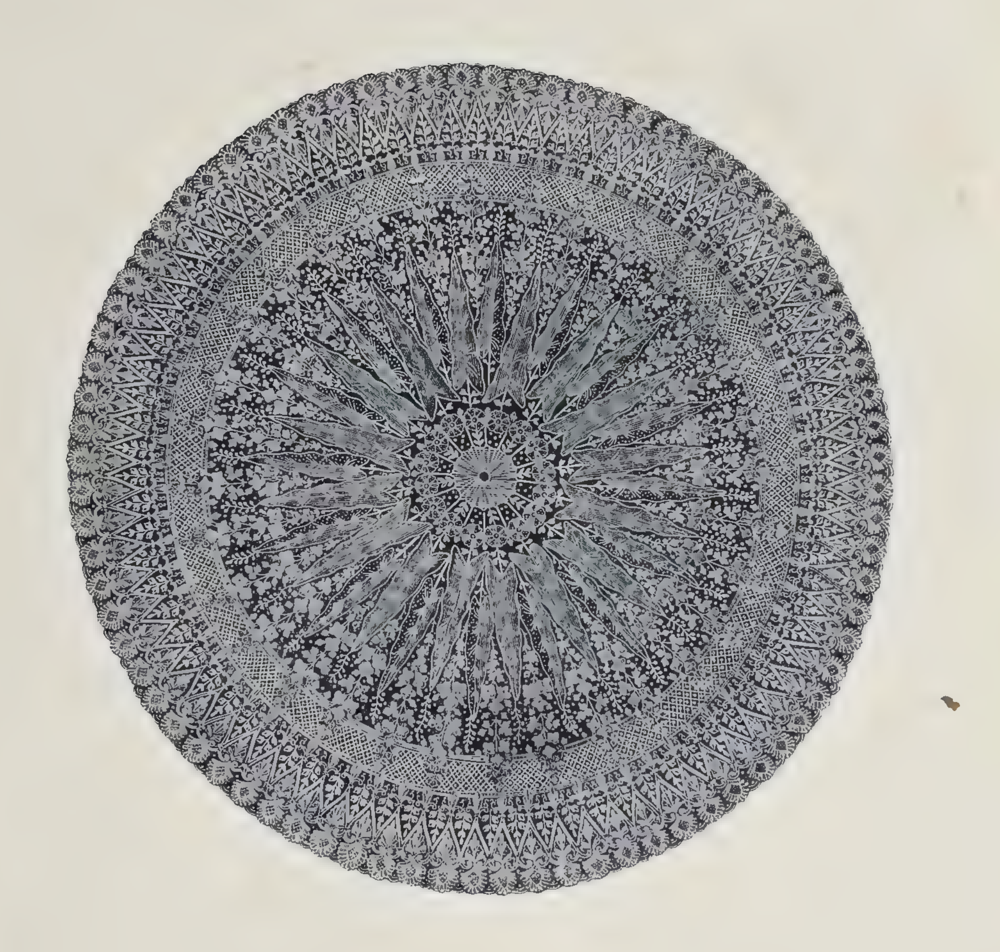




FRENCH TAPESTRY.

THE exquisite piece of Tapestry in the centre, which is shown in its frame, mounted as a screen, for the better effect of the work, is one of the productions of the National Beauvais Manufactory, which defies all competition, except that of its sister Art-factory, the Gobelins: the engraving is on a much smaller scale than the work itself, to get a fair idea of which, suppose the face life-size and increase the ornamentation in the same proportion. A design such as this affords students an admirable study in the harmony in colour, by drawing the pattern on an enlarged scale and then colouring.

The two Borders are the work of one of the most eminent tapestry manufacturers in France, M. M. Braquenié, of Paris; the designs are intended to represent War and Peace, and are remarkable for novelty of treatment and great delicacy.



FRENCH LACE.

A BEAUTIFUL specimen of the lace known as *point à l'aiguille*, produced by MM. Auguste Lefébure et Fils, of Paris. This kind of lace is one of the most delicate fabrics produced, and is peculiarly suitable for the decoration of a parasol, in which lightness is a most desirable element. The design, which is by M. Alcide Roussel, exhibits much novelty and grace, and we have the complete symmetry required without formality. The leaves which radiate from the centre, and the inner border in which they terminate, are peculiarly graceful.





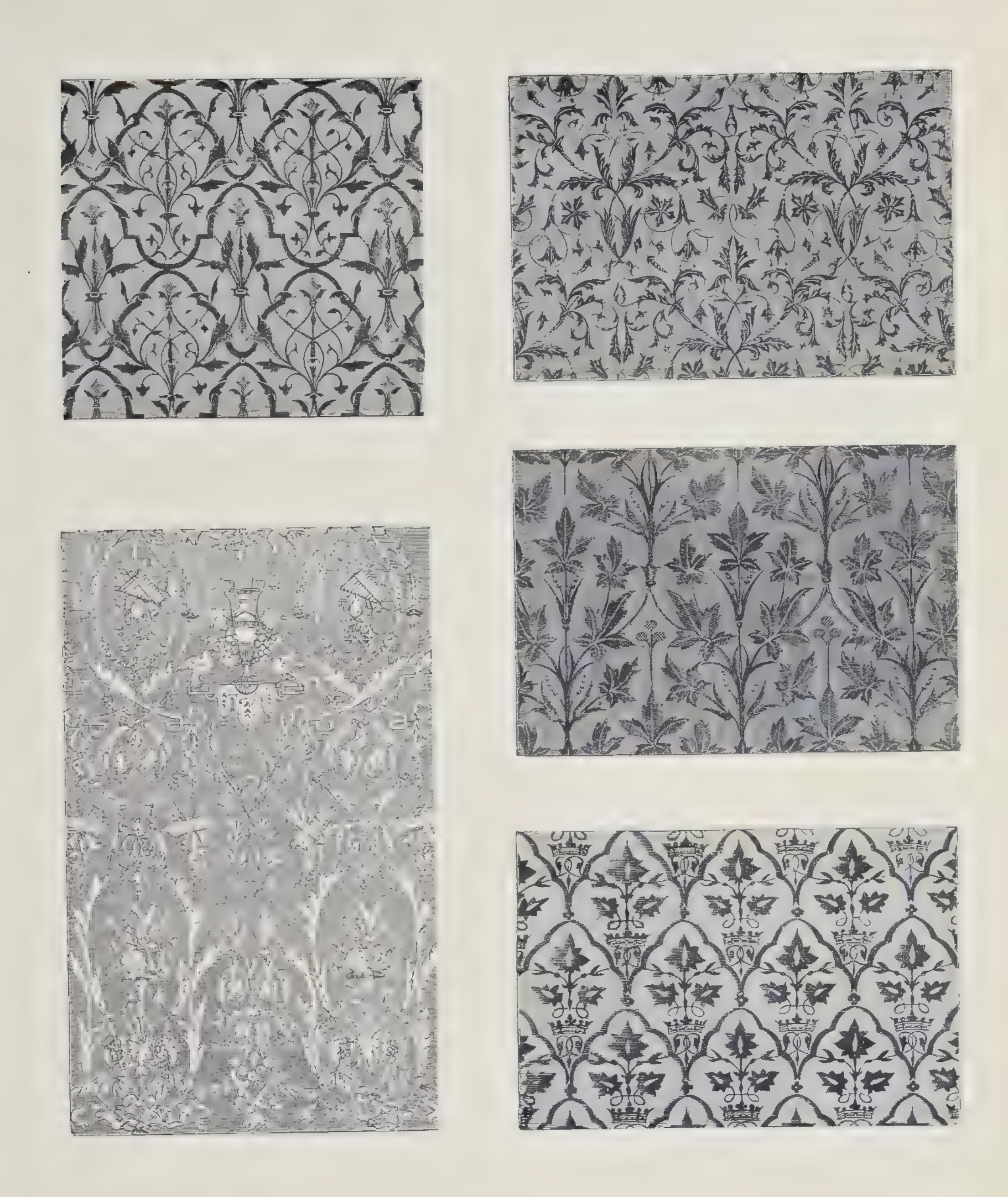
BELGIAN CHURCH EMBROIDERY.

TWO examples of ecclesiastical embroidery, a Stole and a Banner, by one of the most renowned producers of such elaborate work, M. Braughwyn, of Bruges, who for this banner received the reward offered for embroidery by the Roman Catholic Congress of Malines. The design is a fine adaptation of Mediæval ornamentation, the old crozier form being admirably introduced and charmingly treated. It is scarcely necessary to say that the whole of the decoration is embroidered with the needle, and that in the most elaborate manner. It may be objected that the design has too much the character of metal work, but it must be remembered that such treatment is completely in accordance with the traditions of Art as practised in connection with the Roman Catholic Church.



ENGLISH LACE.

DEVONSHIRE has long had a reputation for the beautiful fabric of its lace, and of late years there has been an immense improvement in the designs of this charming work. Amongst those who have been instrumental in bringing about this improvement, Mrs. Treadwin, of Exeter, may be specially mentioned; the lace produced by her has been pronounced as amongst the very best made in this country. The Shawl here engraved was designed, under Mrs. Treadwin's superintendence, by an artist of Nottingham, and the bouquets and wreaths, principally of rose and convolvulus, are very graceful; the formation of a border by means of these flowers alternated, as seen to the right and left of the central portion, is very happy.



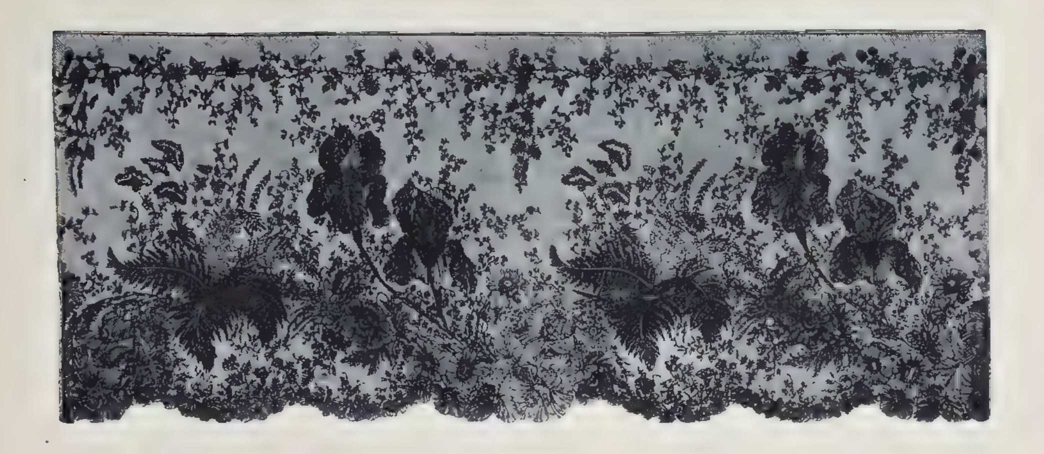
IRISH FURNITURE TERRIES.

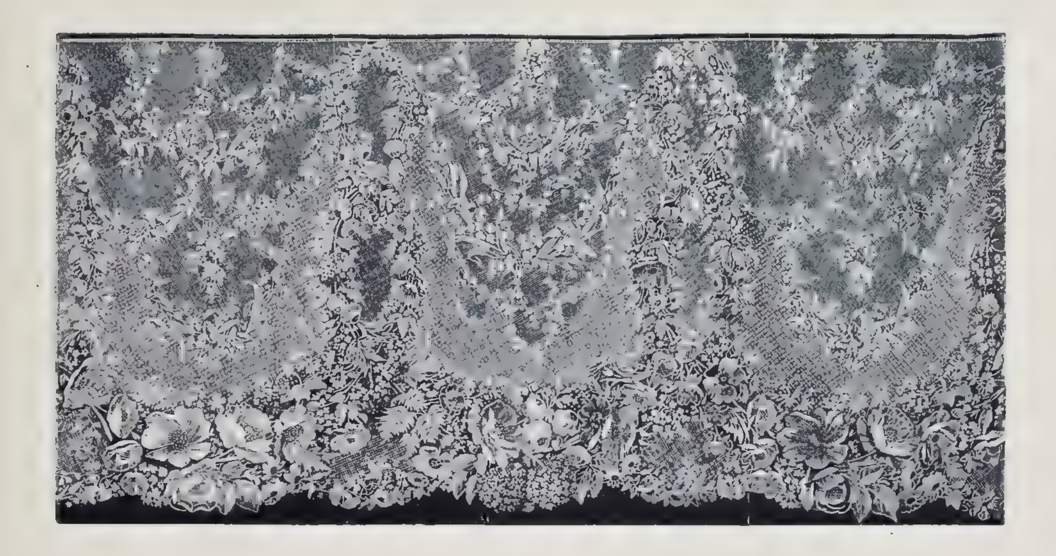
MESSRS. W. FRY & CO., of Dublin, famous manufacturers of poplins, tabinets, and other beautiful tissues, introduced a few years since, into Ireland, the production of figured Terries composed of silk and worsted, for furniture stuffs or curtains, and they succeeded not only in producing excellent fabrics, but in decorating them with much taste, not confining themselves to any particular school or method, as the above examples will show; one of these is an adaptation from the French, the others are elegant diapers formed of the elements of styles more or less remote, but all are well adapted for the purpose to which they are applied.



CASHMERE SHAWLS.

THERE is no country in the world where finer Cashmere Shawls are seen than in England, but some exceptionally fine examples have been contributed to our Exhibitions by foreigners; that which is partially represented above belongs to the latter class. It was shown by the Compagnie des Indes in Paris in 1867. It appears it was made to the order of the minister of a maharajah, and as such magnificent shawls are never made for sale but only for royal gifts, to get possession of such an example must be the result of an extraordinary accident—such as the representatives of the Company in question, which has a factory in Cashmere, would certainly not fail to avail themselves of. The pattern is well shown in the engraving, and the shawl must be imagined as most delicate in fabric and perfect in colouring.





FRENCH LACE.

EXAMPLES of two of the finest kinds of French lace, namely, black Bayeux and Point d'Alençon, produced by MM. Verdé Delisle Frères, or the "Compagnie des Indes," who have attained the highest honours amongst producers of these exquisite fabrics as well as of other varieties, some of which will be found amongst our illustrations. We believe that as regards quality these examples are equal to any lace ever produced in France or elsewhere, and certainly the designs are far superior to those of old lace. We need say little about the designs, they will arrest the eye of any one who has taste; only in examining them it must be remembered that one is black lace and the other white. The Bayeux or black lace of Normandy is remarkable not only for its fineness, but also for the peculiar stitch called *point de ráccroc*, or fine joining, by means of which the lace, which is made in separate pieces, is afterwards joined together.





FRENCH DESIGNS FOR PANELS IN SILK.

THE larger of these designs has been produced in silk by the famous manufacturers of Lyons, MM. Mathevon and Bouvard: we give the design, and wish we could give the brilliancy and harmony of the colours in which it is woven.

The smaller engraving represents a design by a decorative artist of great talent, M. Alex. Wauquier, of Paris, intended for a silk panel. It possesses great originality and beauty, and may be studied with profit even in the reduced form in which it is necessarily presented here, and in which, of course, it appears somewhat crowded. We can imagine how beautiful it would be if woven by MM. Mathevon and Bouvard, or other of the great weavers of Lyons.





FRENCH FURNITURE SILKS.

TWO specimens of the highest class of French Furniture Silks or Room Hangings, by M. F. Duplan & Co., of Paris, who have a high reputation, and maintain it by calling the best available artistic talent to their aid. In the larger example we have Diana, a *Diane chasseresse*, after the famous statue so called, but originally treated, a stag and dog capitally drawn, and fine bold scrollwork and ornamentation, much in the style of old tapestry. In the other specimen we have a simple, original design, full of lightness and grace. We could gladly dispense with the goddess and the demi-figures heading the scrolls, without which we think the design would be all the better.



NORWICH SHAWLS.

THE famous fabric of Norwich, which, we believe, had languished for some years, seems to have benefited as much as other textile manufactures in consequence of the improvements in machinery, chemistry, and design during the last quarter of a century. The example here engraved is the production of Messrs. Clabburn, Sons, and Crisp, one of the most famous manufacturers of that ancient town, who a good many years since introduced a beautiful novelty in shawls, and have since improved upon that. The texture of these shawls is very beautiful, and the shawls themselves are peculiarly light and brilliant without a trace of gaudiness.





FRENCH LACE.

CHARMING examples of the productions of MM. Lefébure, of Bayeux and Paris, who have supplied us with other beautiful illustrations. The larger specimen is a portion of a flounce in Alençon point, designed by M. Alcide Roussel, other of whose designs will be found elsewhere, and who evidently has given great attention to the special requirements and limits of lace manufacture; the bold inner border exhibits a very novel and ingenious application of light and shade, giving the effect of fluting or goffering, not, perhaps, true in a flat design: the flowers and foliage are beautifully disposed. The smaller engraving is of a portion of the Border of a lace curtain in the style of the old flat Venetian point; the design of this is charming, the scrollwork is beautifully treated, and the corner is full of airy grace that is delightful to the eye.



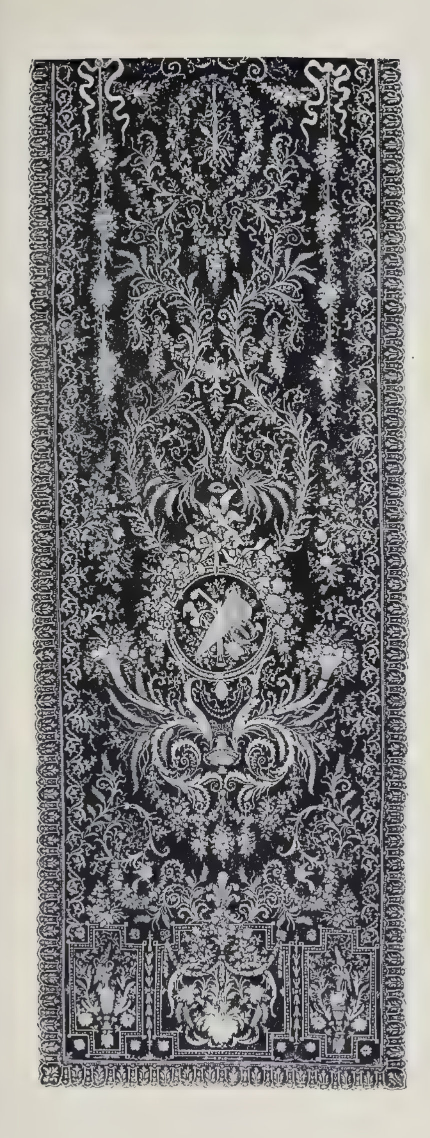


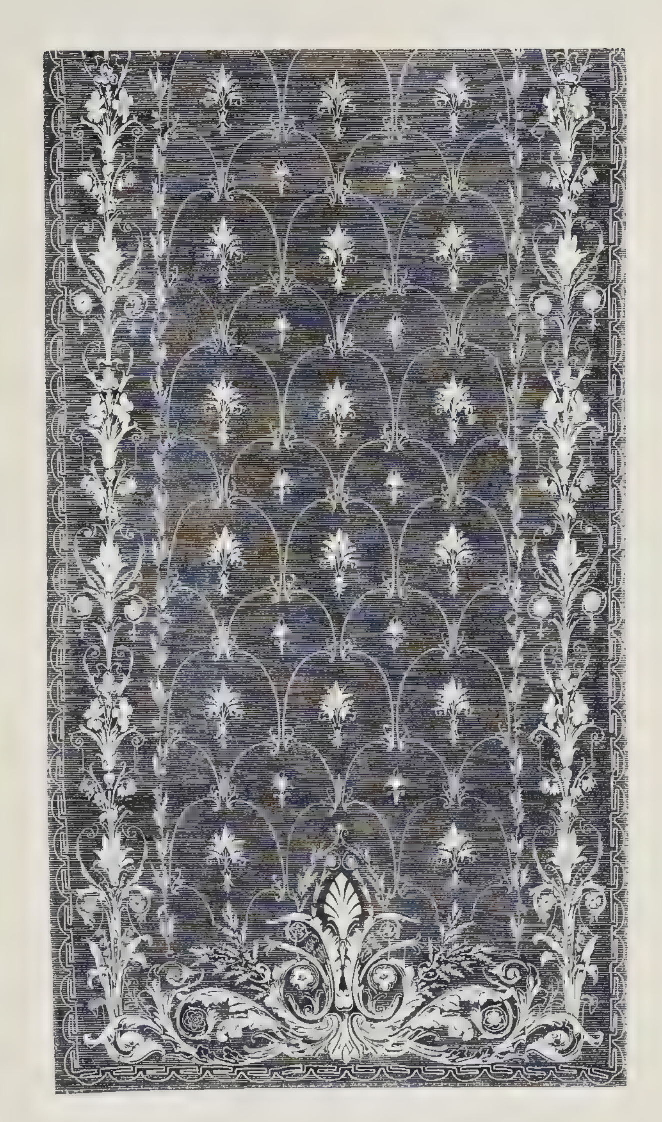




ENGLISH SILK AND WOOLLEN BROCADES.

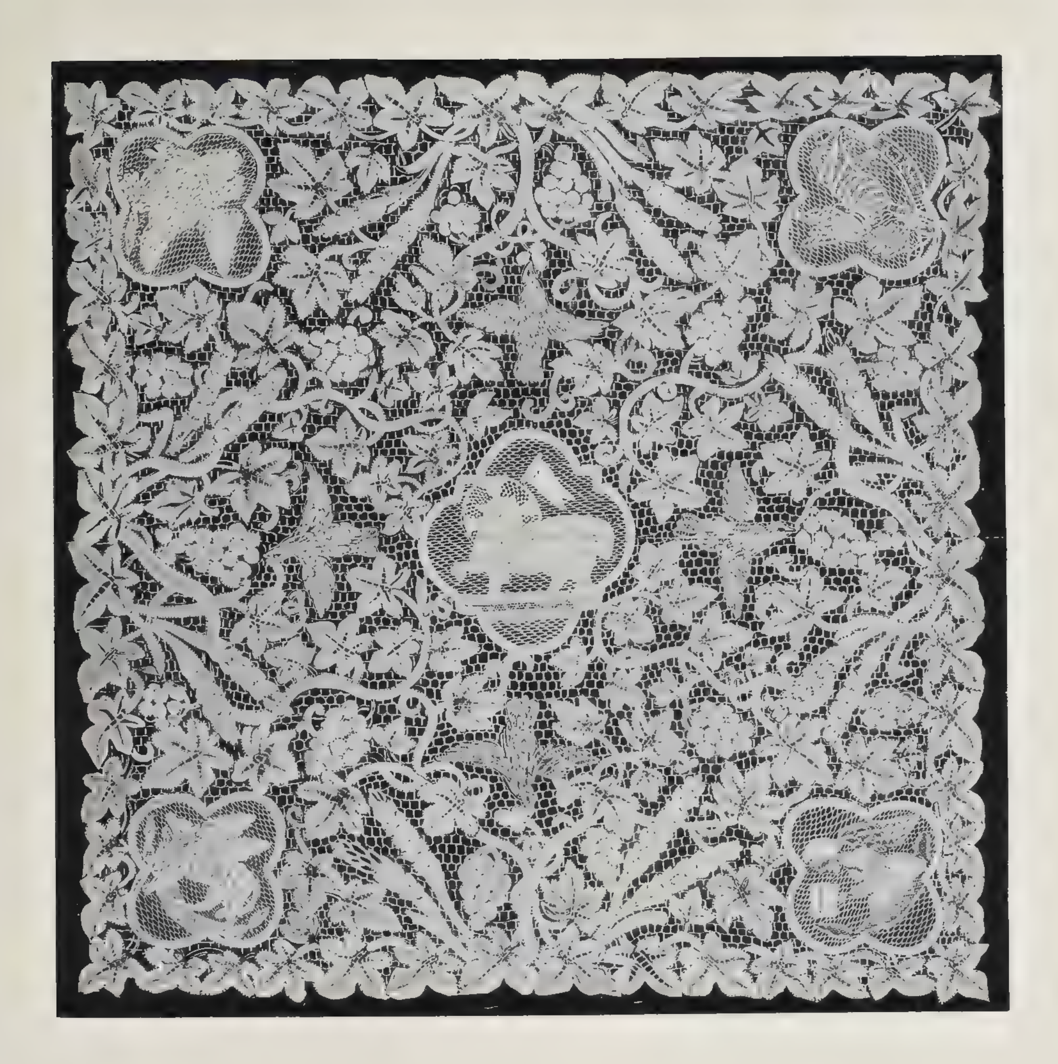
VERY beautiful and not extremely costly fabrics for upholstering purposes, manufactured by Messrs. J. W. and C. Ward, of Halifax, from designs by Dr. Cornelius Dresser, who has done much excellent work not only in Art-decoration but also in the inculcation of the principles on which it rests. Dr. Dresser has given great attention to botany and the application of natural elements in ornament, and consequently has acquired remarkable skill in floral design, but he has also studied thoroughly the best examples of all the Oriental styles, and especially the Japanese, of which he is master. The results of these studies, and of a most skilful pencil and good eye for harmony of colour, have been an immense number of beautiful patterns for wall papers, china and other ceramic wares, silks and other decorative fabrics. The four specimens here given are fair specimens of Dr. Dresser's taste and skill.





FRENCH EMBROIDERED CURTAINS.

OUR neighbours have certainly brought fabrics of this sort to great perfection, and the study of the designs which decorate them is invaluable to the student of applied Art. France has for a long period been famous for textile productions in silks, linen, and woollen, but her designs were never so pure as they now are; from the time of the Renaissance her Art-manufacturers have progressed with little check; the style known as that of Louis-Quatorze had good bold features of its own, but was marked by an intentional departure from symmetry; in the following reign the fashion ran wildly to what is known as rococo, but Louis-Seize work was full of delicacy. Under the Empire there was a poor lavish imitation of Roman decoration in most departments, but the artists since that time have studied nature more than they ever did before, and they have applied their observation with the aid of much really good artistic training. These two specimens, the production of the "Maison Blanc" of Paris, M. Leopold Mennier, director, are certainly admirable examples of their class; the ornamentation is beautifully drawn and artistically composed: we would draw special attention to the border and ornament at the foot of the larger curtain. As French curtains are hung flat the designer has more scope for his Art, or rather the design tells with fuller effect and may be more decided.



DEVONSHIRE LACE.

We have already given one example of the beautiful Lace designed and worked under the superintendence of Mrs. Treadwin, of Exeter; and here is another. It is a chalice cover of the finest handwork, and a remarkable specimen in all respects. The design requires little explanation: in the centre is the Lamb with nimbus and flag; in the corners are the emblems of the four apostles, and midway are four doves descending from the centre. Mrs. Treadwin claims to have produced these symbols in a new manner, which she calls "lace embossing." The ornamentation is appropriately composed of the "fruits of the earth," and the effect of the whole is very rich, and does great credit to the poor Devonshire women as well as to the talented designer.









IRISH TERRIES.

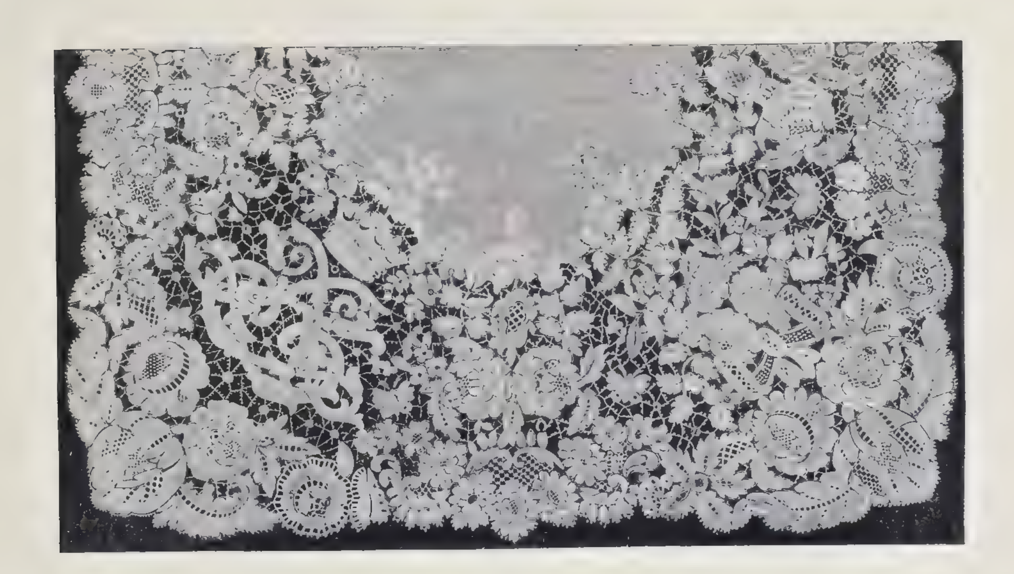
THE four specimens here engraved represent Terries composed of silk and wool, like the English brocades already given, for curtains and upholstering work. They are the manufacture of Messrs. William Fry & Co., of Dublin—famous makers of the excellent mixed fabric called poplin, which has a European reputation—who, we understand, introduced the manufacture of terries into Ireland, and thus gave rise to a new and highly successful trade. The material has a peculiar richness and metallic lustre which render it admirably fitted for upholstering purposes, and it is considerably cheaper than stuffs composed of silk alone. Messrs. Fry have wisely given great attention to design as well as to material and fabrication, and have consequently won for these terries high praise for excellence in both respects. The four patterns here given are capital examples, all showing study and originality.



NORWICH TAPESTRY.

TAPESTRY composed of silk and worsted, by Messrs. Clabburn, Sons and Crisp, of Norwich, who have been extremely successful in the production of these beautiful tapestry stuffs. The design in the example before us is remarkable; it is the work of Mr. J. Funnell, who has presided over the artistic department of the establishment. The ornamentation reminds one of ancient work, but the details are treated in an essentially original manner; the scroll-work is drawn with a firm hand, and the arrangement of the conventional figures in horizontal lines crossing and intercepting the diagonal stripes has a novel effect.





HONITON LACE.

TWO examples of the finest Honiton Lace, exhibited by Messrs. Howell and James: the first is a portion of the bridal veil worn by H.R.H. the Princess Louise, Marchioness of Lorne, on the occasion of her marriage, and there is this additional interest about it that the pattern of it was from a sketch by the Princess. This pattern, in consequence of the large size of the veil and the necessarily small scale of the engraving, shows to little advantage, but in the veil itself it had a very chaste and elegant effect. The second engraving represents half of the Princess's handkerchief.



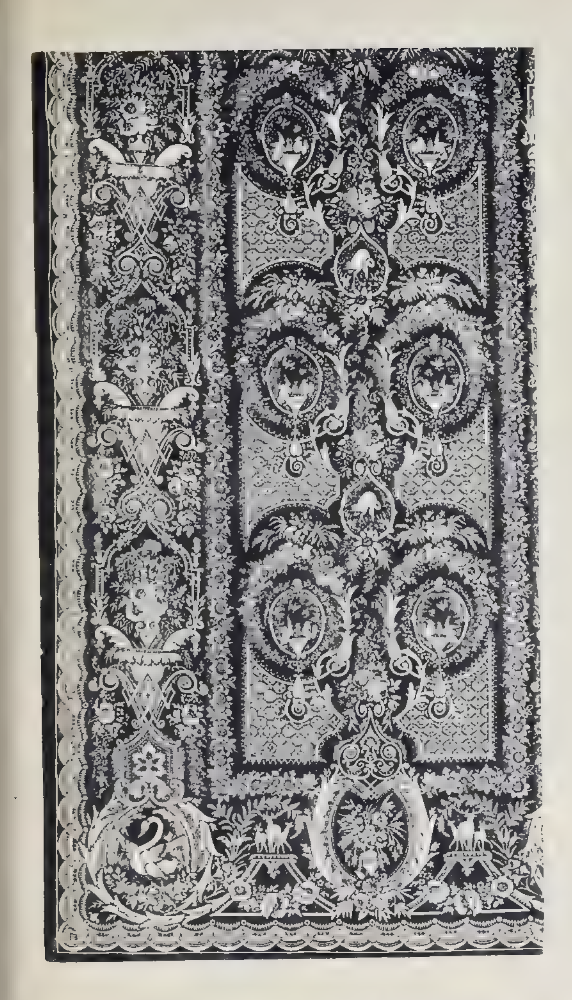


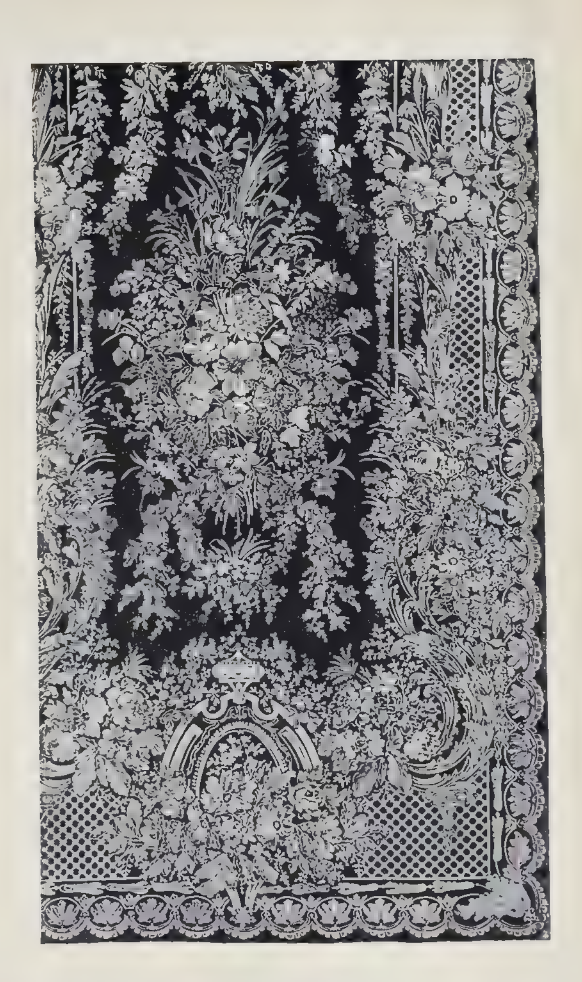


ENGLISH LACE CURTAINS.

THE two larger engravings represent Lace Window-curtains, the manufacture of Messrs. Jacoby & Co., of Nottingham. These curtains are machine-made, in imitation of the Swiss embossed curtains, and, while very much less costly, are stronger, more durable, and better in effect, more varied in light and shade. The width of our page has compelled the cutting off a portion of each curtain, but as the patterns are what are called "repeats," that is to say, having a centre with two sides alike, this does not seriously affect them. The designs are excellent.

We take advantage of the small amount of space left below the curtains to introduce a charming example of Brussels Lace exhibited by Messrs. Debenham Sons and Freebody, of London, in 1862; it is part of a rich flounce executed in "point d'aiguille" and "plat" mixed. It was designed by M. Bormod, of Brussels.







ENGLISH CURTAINS AND FRENCH LACE.

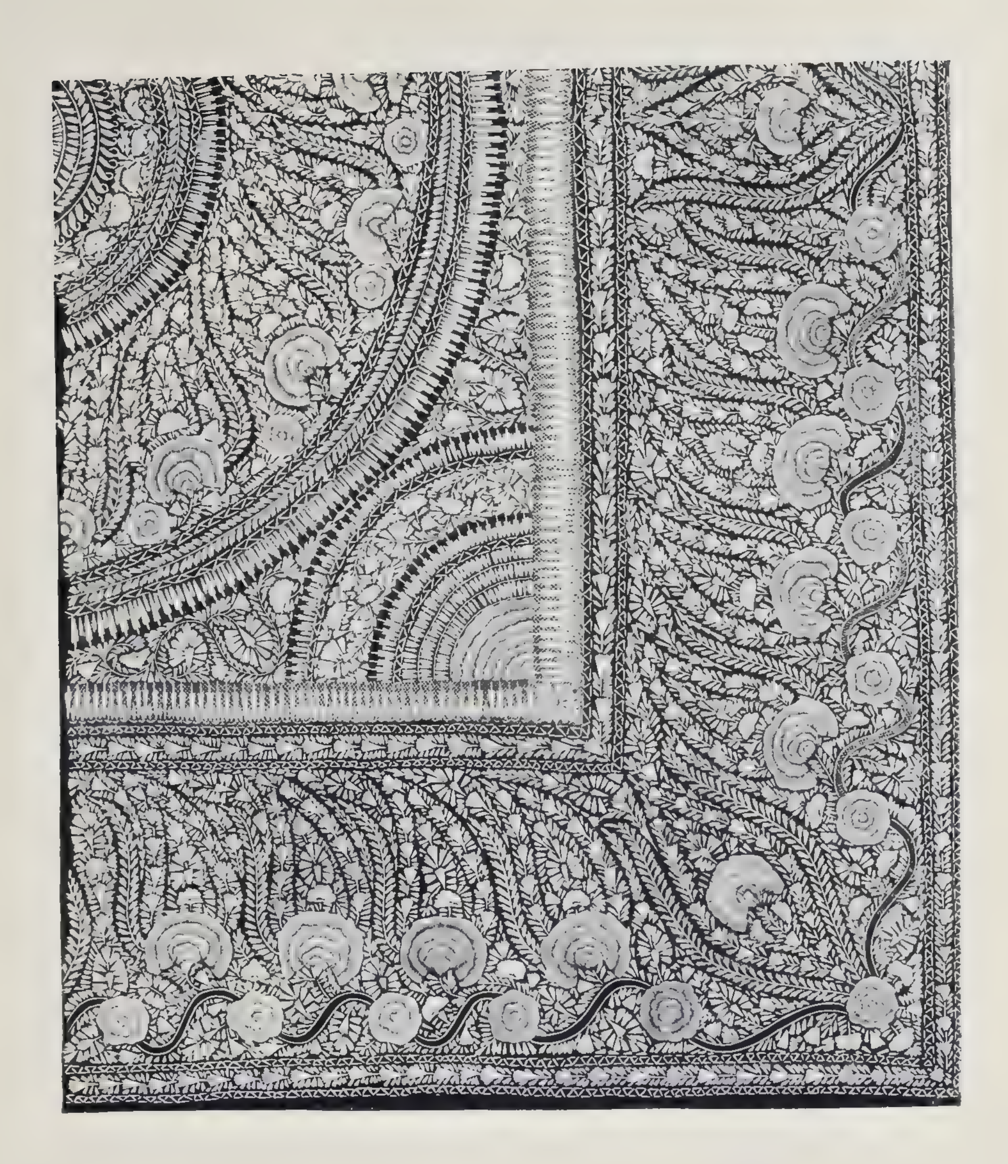
TWO more excellent examples of Nottingham machine-made Lace Curtains, these being the production of Messrs. Simson, May & Co. The fancy, the elaboration, the labour that have been brought to the manufacture of these beautiful productions, which ornament almost every house in the three kingdoms and thousands abroad, almost surpass belief. Here, as in other cases, we have been compelled to cut off a portion of the design, but being "repeats," it is of little moment.

We find space here for the insertion of a beautiful band executed in "point Colbert:" it is executed in very high relief, surpassing the ancient point de Venise. The design for this band was drawn for MM. Auguste Lefébure et Fils, of Paris, by M. Alcide Roussel, whose names will be found on other sheets of this work.



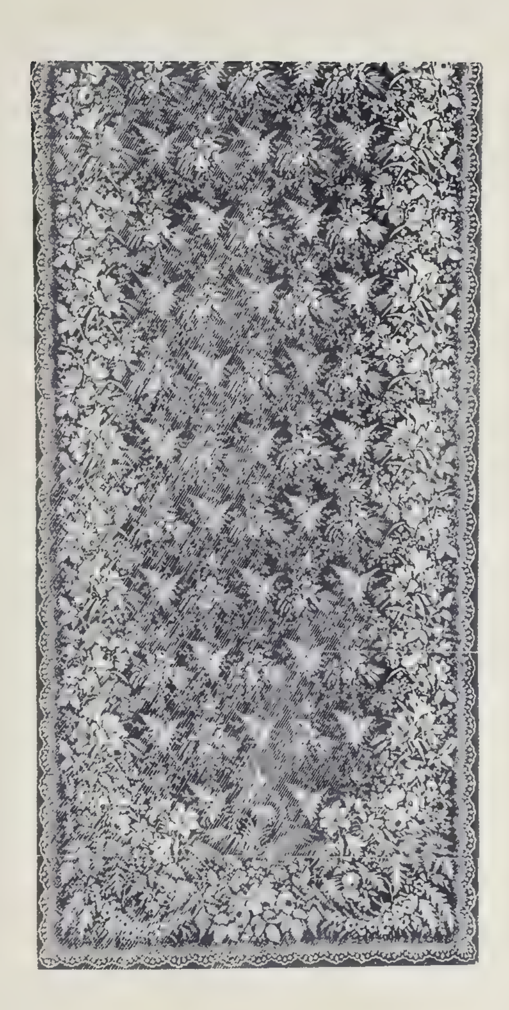
IRISH DAMASK.

SEVERAL specimens of the beautiful Damask Table Linen of Belfast have already been given in these pages, but the Table-Cloth represented above, by Messrs. John S. Brown and Sons, is deserving of special notice. The design is of a novel and ambitious character for its purpose, but the artist—we are sorry not to know his name—has proved his right to be ambitious; he has produced a very remarkable work—rich, full, yet distinct. We scarcely know which to admire most —the charming grand scroll, with *cupidons* in Quinque-cento fashion, or the stately border. While Belfast produces fabrics like or worthy of this, she need have little fear of rivalry; not that we would counsel her to rest on her laurels, but, on the contrary, to keep them fresh and growing.



INDIAN EMBROIDERED SHAWL.

THE Cashmere shawl, Dacca muslin, enamels, and other decorated productions of India are well known, and, what is of infinitely more importance, they have been highly appreciated, not only in this, but in all the countries of Europe; and more, they have taught the Art-workman more about colours than anything else in the world. The engraving here given represents an article not included in those above mentioned, and which is rather rare; it is a Shawl of black net embroidered with floss silk, the production of Manuck Chund, of Delhi. The amount of work, the time, the patience required to produce such a piece of needlework must be prodigious.





ENGLISH LACE CURTAINS.

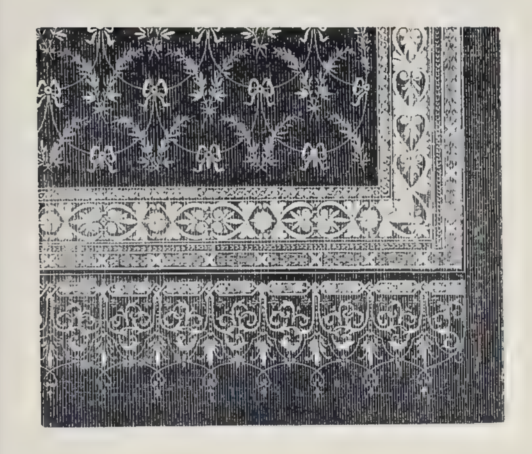
OUR space is nearly exhausted, and we devote this and the few remaining pages to the illustration of textile manufactures which appeared at the Philadelphia Exhibition of 1876.

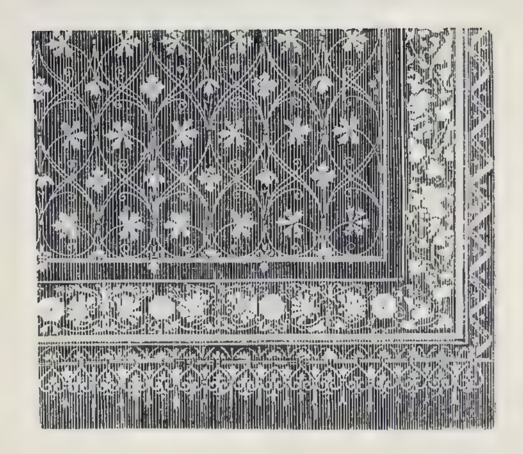
The two engravings here given are selected from the fine collection of Muslin and Net Curtains contributed by Messrs. Hayman and Alexander, of Nottingham, who hold a high place amongst the manufacturers of that town for the excellence and good taste of their productions. These and most of the designs worked by this, and indeed nearly all, the curtain weavers of Nottingham, are made of flowers and leaves with a few accessories, and such patterns are certainly much better adapted to the purpose than geometric diapers, or large complicated designs, which cannot be seen when the curtain is in folds. The two examples before us are excellent.

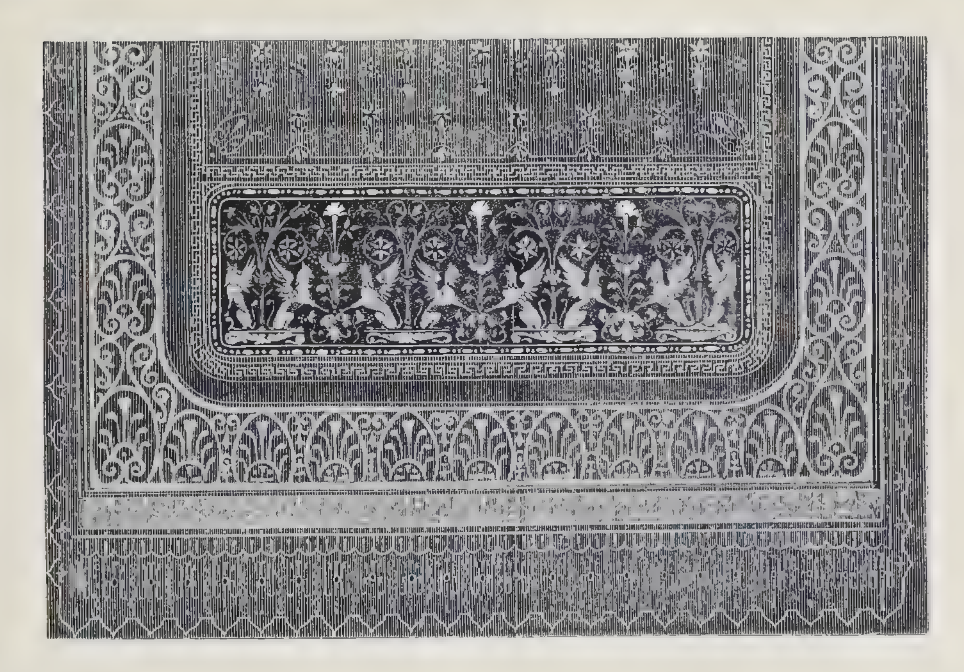


ENGLISH LACE CURTAIN.

WE give here a representation of a superb specimen of machine-made Lace, by Messrs. Jacoby & Co., of Nottingham, whose productions have already supplied us with several subjects. A few years since no one would have supposed it possible that such a complicated piece of lace-work could be produced in a machine of any kind, yet every stitch in this curtain is regulated by the Jacquard apparatus included in a complete lace-loom. The design is very rich and graceful, the festoons connecting the central medallions and borders artistically arranged, and the flowers and foliage well drawn. The specimens exhibited at Philadelphia by this and other firms did our manufacturers the highest credit.



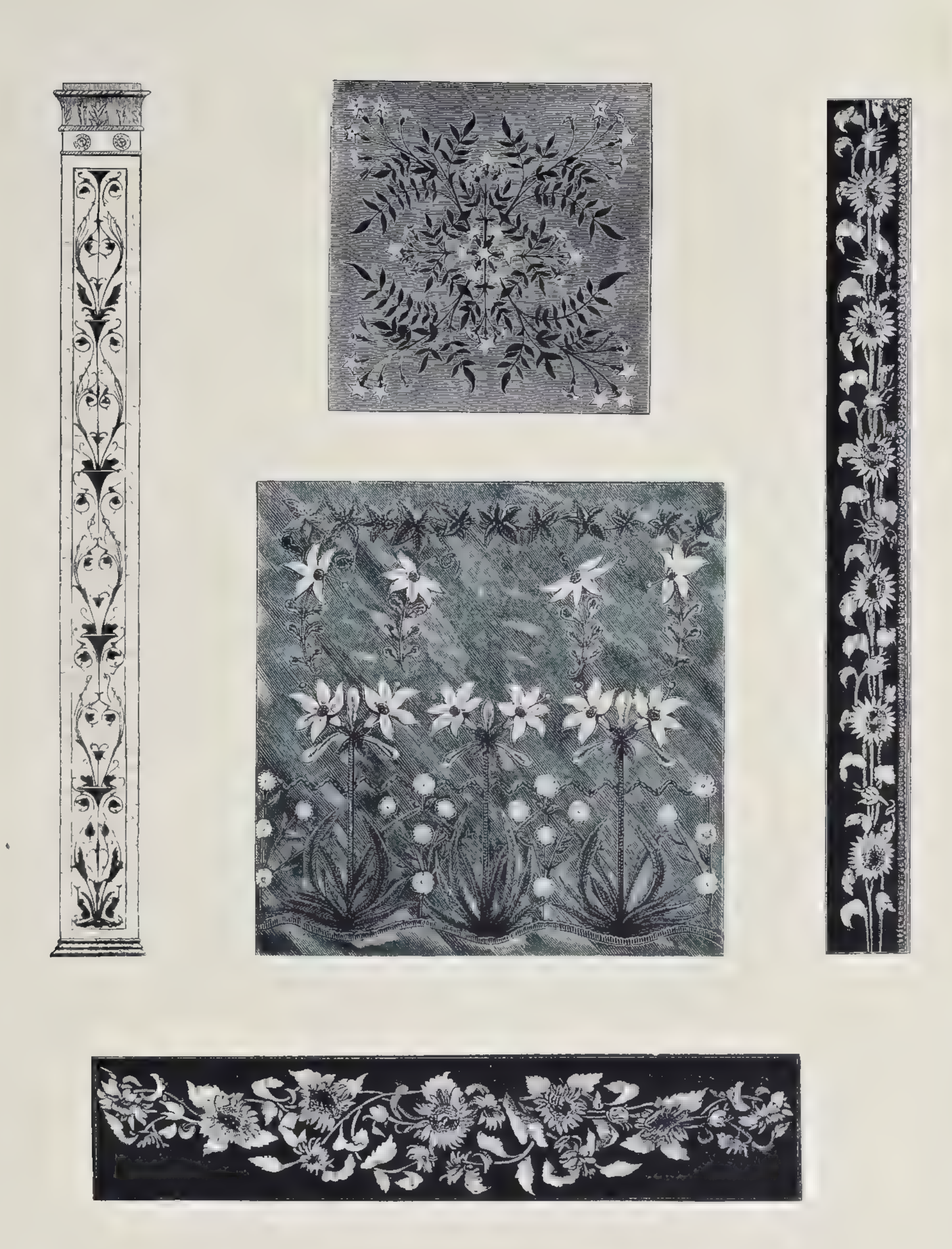




SCOTCH CURTAINS.

EXAMPLES of Curtains woven all in one, borders included, by Messrs. J. and J. S. Templeton, of Glasgow—admirable specimens of figure-weaving on the largest scale. It is the decoration, however, which most interests us at present. We have had cause to draw attention many times to the knowledge and skill of French designers, and we are glad to be able to produce many specimens of English Art-work fully worthy of the same high praise; and here we may mention that our readers must not be surprised that nearly all the illustrations we produce are highly spoken of, for we do not produce bad examples for criticism, but those which we think good for emulation. It would be difficult to find three examples deserving of higher praise than those before us; the patterns are all beautiful, from the simple diapers of the grounds to the most severe and most ornate borderings. The manner in which the classic elements have been adapted is remarkably happy. Where all is so good, it is almost needless to select beauties, but we cannot avoid pointing out specially the fringe-like border at the bottom of the first example, the beautifully composed inner border of the second, and the sumptuous frieze—we can find no other term so appropriate—with the winged griffins, in the large engraving. The materials are silk and wool.

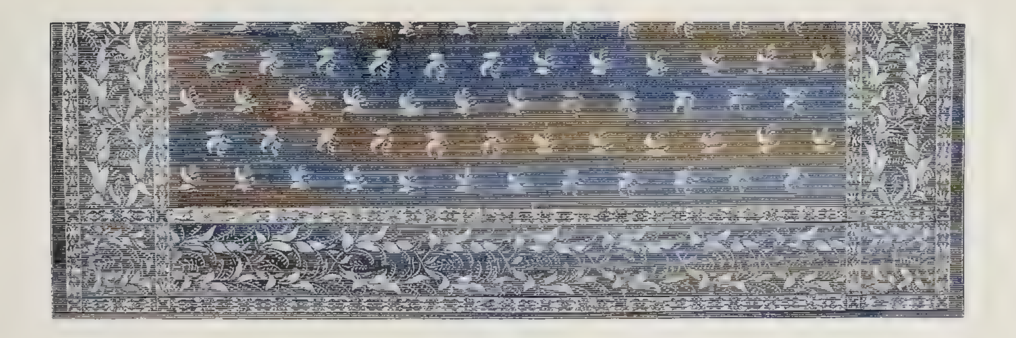
These beautiful productions were exhibited in 1871 at South Kensington.



ENGLISH EMBROIDERY.

A SMALL selection from the needlework sent to the Philadelphia Exhibition by the establishment at South Kensington for promoting the interests of ladies by the production and sale of works embroidered by them. This establishment is under Royal patronage, and is doing good service. Some of the ladies draw as well as work, and their productions have attracted attention and purchasers. There is no special object in the establishment except that of aiding ladies who require it, so that there is no limitation with respect to the kind of articles decorated by means of the needle. The designs given here are all good, and the work reflects the highest credit on our countrywomen.

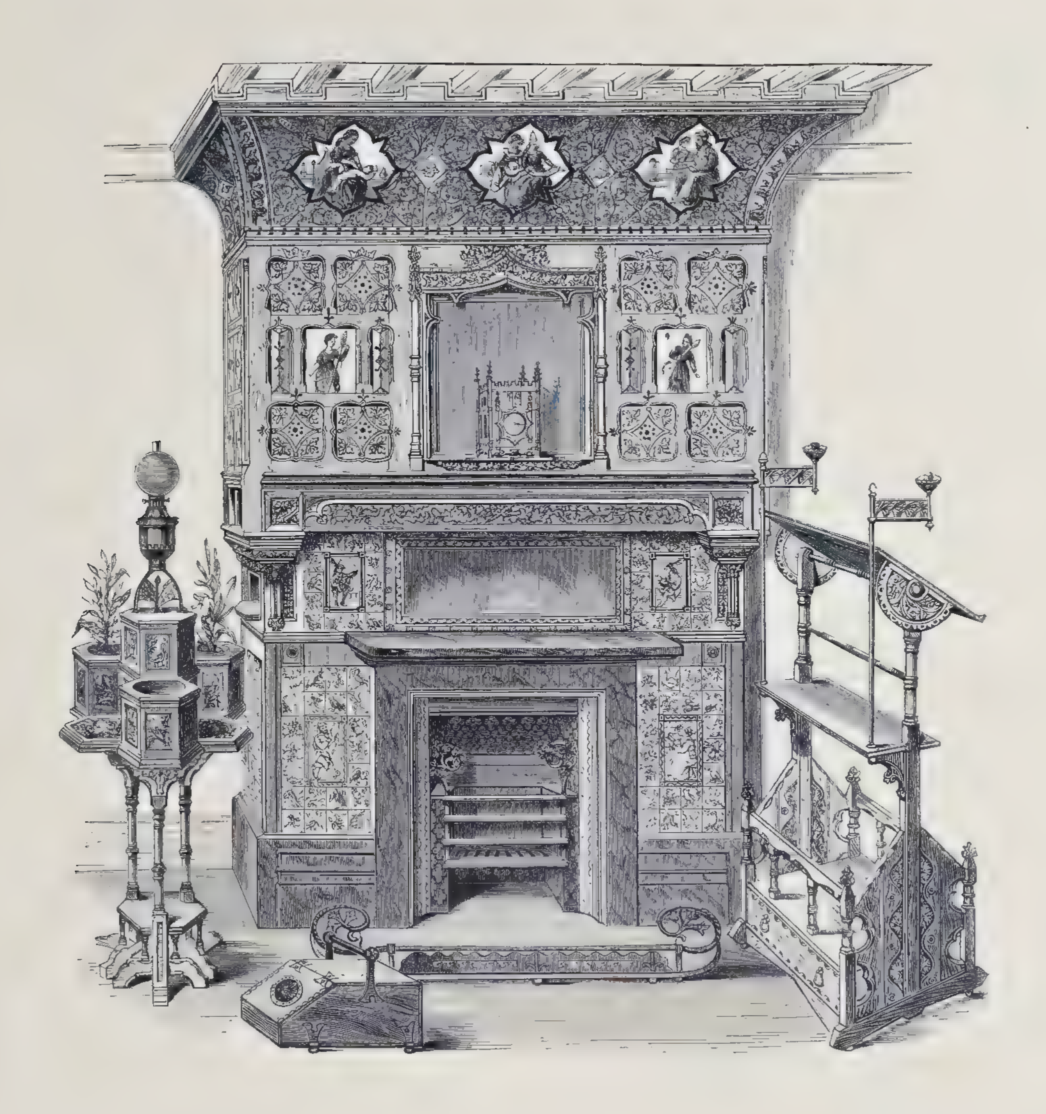






IRISH DIAPER.

SPECIMENS of the beautiful decorated Table-linen produced by Messrs. John S. Brown & Co., of Belfast, who occupy an eminent position, have already been given in these pages, but we are pleased to add some more examples from the collection shown by the firm at Philadelphia. The quality of Irish linen is well known to all the world. The designs, we hope, will speak for themselves; we need only say that they are well drawn and appropriate. Every Art-manufacture has its appropriate method of decoration, and here we see simple centres and ornate borders. It is of little use wasting labour and money in producing splendid patterns in the middle of a table-cloth, which is to be covered whenever it is in use with a plateau or some other centre-piece. It is only in the case of very large cloths that there is room between the plates of the guests and the pieces of the table-service to allow of the introduction of an inner border, or running ornament. One or more good examples of such large cloths will be found in this work.



ENGLISH MODERN MEDIÆVAL WORK.

A GROUP of productions by the well-known firm of Cox and Sons, of London, namely, the end of a room in stone in the old style, with marble mantelpiece and decorations in hand-painted tiles, shown in 1872. The general form of the work is extremely effective, and especially that of the bracketed portion over the glass, with its elegant corbels and tracery above. The coving is elaborately carved, and is further decorated with painted panels—subjects, "Maternal Affection," "Conjugal Affection," and "Filial Affection." The subjects in the central panels right and left of the clock are "Work" and "Play;" and the four below, "The Song," "The Tale," "The Jest," and "The Book." The frames of the glasses are in carved oak. The Fender is a capital example of severe and appropriate wrought-iron work. The piece of furniture towards the right hand is novel in construction, combining the Canterbury and Reading-desk combined, admirably designed. On the other side is a somewhat novel arrangement for holding flowers and a lamp.



DECORATIONS AT VERSAILLES.—Sheet I.

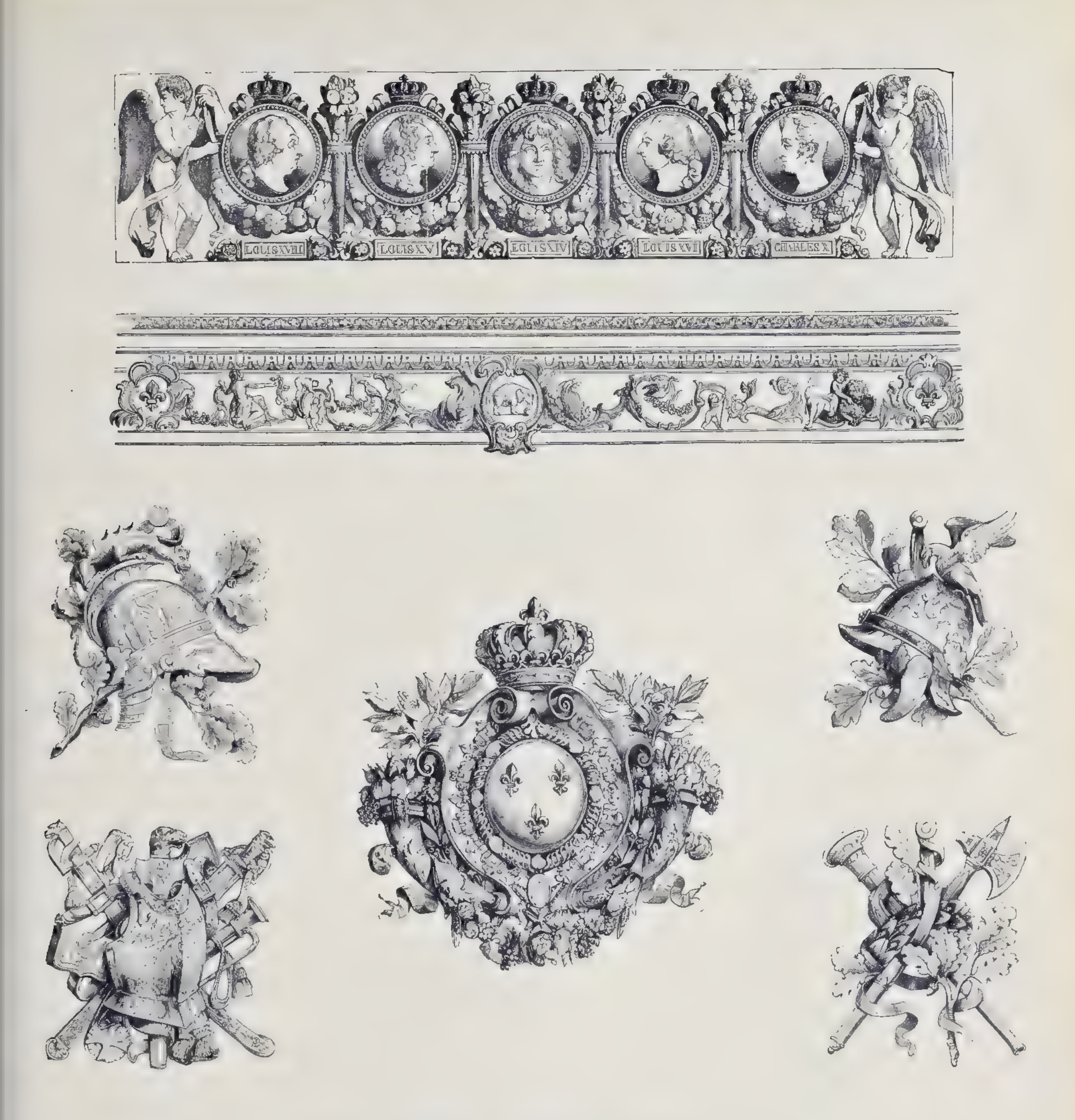
THE decorations on the walls and ceilings from which the accompanying illustrations are taken, are the works of the principal artists of France engaged by Louis-Quatorze and succeeding kings of France, and are of the style of ornament which now bears the name of that monarch.* Our first engraving is from an ornament in the Chapel; it exhibits above and below a combination of warlike paraphernalia, and in the centre a medallion of a sacred subject, supported by a pair of winged demi-figures.

The Chapel also supplies us with two subjects of winged figures of very graceful design from the ceiling; and slight as they appear, they show the correctness of form and beauty of outline for which the artists of France have long been pre-eminent. The *pose* of these figures is remarkably easy.

The engraving in the middle, on the right hand, represents a "Fire-dog;" it is exceedingly rich and beautiful.

The five Medallions extending across the top of Sheet II. are of later date, from the "Meuble de Charles X.," in

* Engraved in M. Gavard's "Versailles, Galeries Historiques."



DECORATIONS AT VERSAILLES.—Sheet II.

the Gallery of Statues; as will be seen, they are portraits of the later French monarchs, and the series is terminated at each end by a winged figure.

The cornice beneath is copied from the Salle des Maréchaux, a noble apartment, containing, as its name implies, portraits of the Marshals of France from the earliest annals of the country to the present time. Many of these portraits are by the first artists of their respective periods.

The four small ornaments below are taken from the Bosquet des Dames; they are all composed of the implements of warfare, some of them being interspersed with leaves, and tied with bands of ribbon. The grouping of these several objects is well managed: the various galleries which are devoted to the illustration of the military and naval glories of the country are filled with an infinite number of similar designs, yet differing in their component parts.

The beautiful heraldic device which is placed between the ornaments appears in M. Gavard's work, on the page that describes the "Institution of the Military Order of St. Louis." The centre, containing the fleur-de-lys of France, has for



DECORATIONS AT VERSAILLES.—SHEET III.

supporters two cornucopiæ filled with flowers, the horns themselves being almost concealed by floriated ornament; the whole is surmounted by the royal crown.

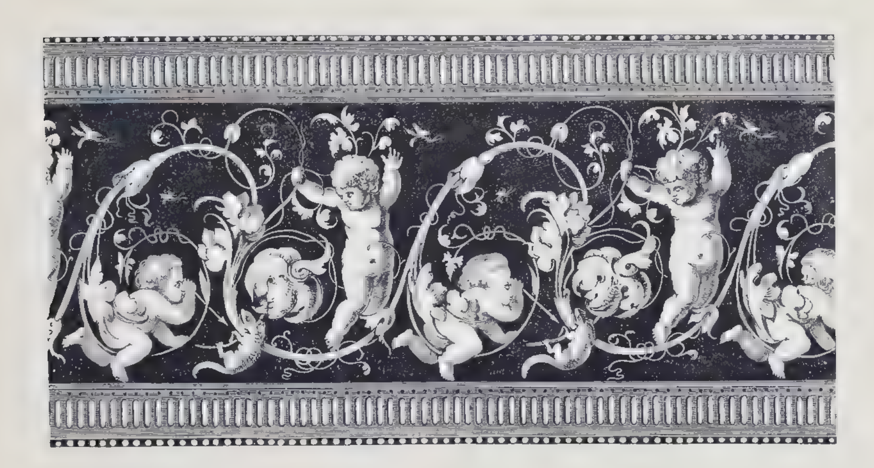
The ornament at the top of Sheet III. is from the Aile du Nord, and from that portion of it which contains the portraits of the great artists of France: the figures supporting the shield are in perfect harmony with the appropriation of the gallery, while the base of the device is composed, with much elegance, of scroll-work mingled with acanthus leaves. The two ornaments on the sides are from the Cabinet des Bains. The composition of these groups quaintly identifies them with the use of the apartment; we recognise in them the various articles indispensable to the enjoyment of the luxurious and healthful bath—reeds and bulrushes typical of the fresh and purifying stream, small vases for holding water, combs, brushes, sponge, bottles of *cosmétiques*, curling irons, &c. The two smaller cuts on this sheet are also composed of objects having reference to water—dolphins, shells, aqueous plants, &c.

The decorations of the famous Château deserve careful notice; artists, designers, and amateurs will find in them abundant material for study and consideration, though not always for admiration, still less for imitation. The palace, both externally and internally, is a grand museum of Art which is an honour to France.









FRENCH PAPER-HANGINGS.

THE quaint Scroll Paper at the top, with the admirably drawn animals and the clever general composition, and the second, which is intended for a cornice, are by M. Delecourt, a famous Paris manufacturer.

The third is by another celebrated Parisian firm, MM. Hulier frères: it is printed in gold on a white ground; as a bit of Italian Renaissance design it is admirable.

The last example is a fanciful Border by Mr. Muckley, master of the Burslem School of Art.





FRENCH AND ENGLISH MANTELPIECES.

THE engraving above represents a portion of a beautiful Chimney-piece, exhibited by M. Lebrun, of Paris, in 1851. The foliated bracket beneath the middle of the mantelshelf is very bold and effective. Many clever sculptors are engaged in this class of work in Paris: they work in their ateliers and at their own risk.

The second figure is that of a magnificent Chimney-piece, 9 feet in width, exhibited at the same time by Messrs. Brine Brothers, of London: it is from the design of Mr. T. Sharp, and is executed in statuary marble, richly carved, and decorated with electro-gilt metal ornaments on the pilasters and frieze and in the spandrels. In the last are the initials of her Majesty the Queen and of Prince Albert, intertwined with the national emblems—the rose, thistle, and shamrock.

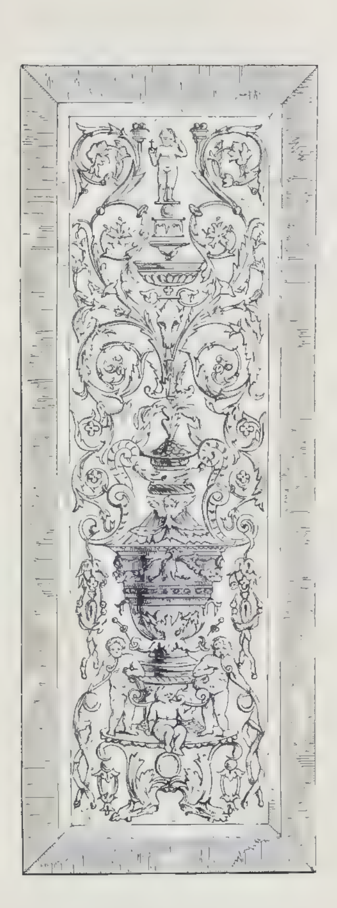


PARIS CHIMNEY-PIECE.

A GRAND Chimney-piece exhibited by MM. Huber at the Paris Exhibition of 1855, we believe for one of the apartments in the Luxembourg, and, of course, in the somewhat overloaded style of the decorations of that edifice. The designer and sculptor have performed their work admirably. It should be remembered, in judging of the ornamentation, that the work itself is of very large size, and this style of ornament is far better suited for large than for small surfaces.







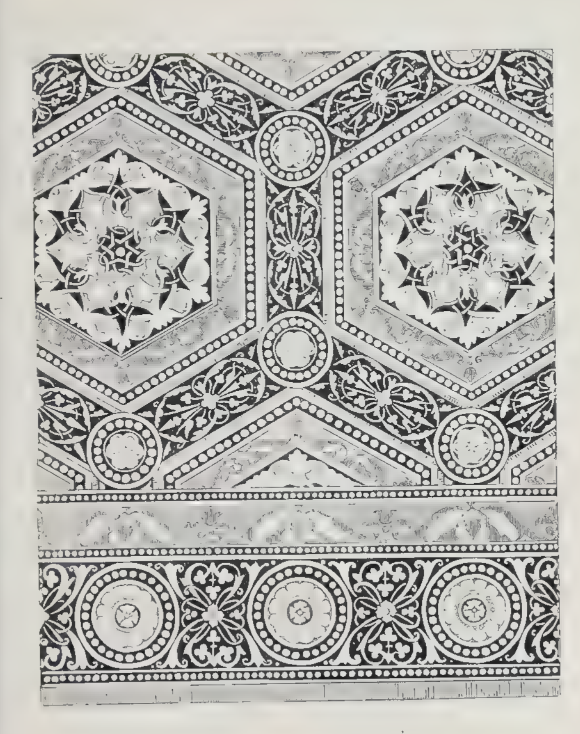
ENGLISH AND FLEMISH PANELS.

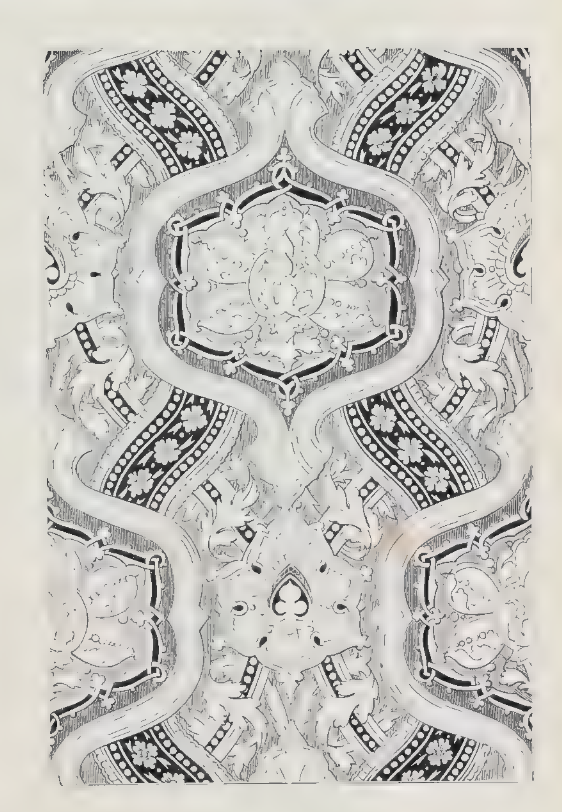
THE first of the three illustrations here given is that of a beautiful decorative Panel, from the works of Messrs. Copeland & Co. It is intended for a fireplace: the design is graceful, and requires no explanation; the colouring calls for a few words. The medallion in the centre is executed in colours on a black ground, the scroll-work above and below is enamelled on a ground of gold, and the border is in burnished gold relieved with blue. The general effect is rich and harmonious.

The central figure represents a charming example of Silk-Damask for hangings, manufactured by Messrs. Walters and Son, of London.

The last figure represents an excellent specimen of a Flemish Renaissance Panel belonging to the South Kensington Museum.







FRENCH ORNAMENTATION.

THREE beautiful designs by an artist of great talent, the late M. Clerget. The panel presents an example of remarkably original design after an illuminated manuscript in the Bibliothèque Nationale of Paris. The other two engravings are original designs for carpeting: they are Persian in style and magnificent in gold and colours, but without the aid of brilliant metal and gorgeous tints the designs themselves are exquisite. The features of these two remarkable works are all beautiful; perhaps, if any be more admirable than the others, they are the hexagonal panels of the darker example—altogether this design is a marvel of perfection, the beauty of the border, and its modification as applied to the hexagonal panels, are striking; yet the companion design loses nothing by comparison. Together, they form a highly valuable study for the student in decorative design. Not having seen the originals, we cannot say how much of the credit is due to the painter of them and how much to M. Clerget, but the condition in which they are left by him tells how admirable must have been his taste.



BELGIAN SCULPTURED MANTELPIECE.

ONE of the most magnificent works of its class that appeared at the Great Exhibition of 1851, executed by M. Leclercq, of Brussels, for the King of the Belgians. It presents a rare combination of knowledge of Art, aptitude in design, and ability in execution—a true Art-work. Belgium may well be proud of her artistic productions, for they exhibit the influence of her great sculptors; artists, like M. Simonis who produced the noble statue of Godfrey de Bouillon, not only aiding designers in their work, but themselves producing admirable designs for works in marble, in iron, in bronze, and in gold. When this superb Chimney-piece was executed, previously to the Great Exhibition, there was little of that connection between artists and Art-workmen which had produced marked results on the Continent; but the collaboration had already been commenced, and fortunately has since been constantly extended.



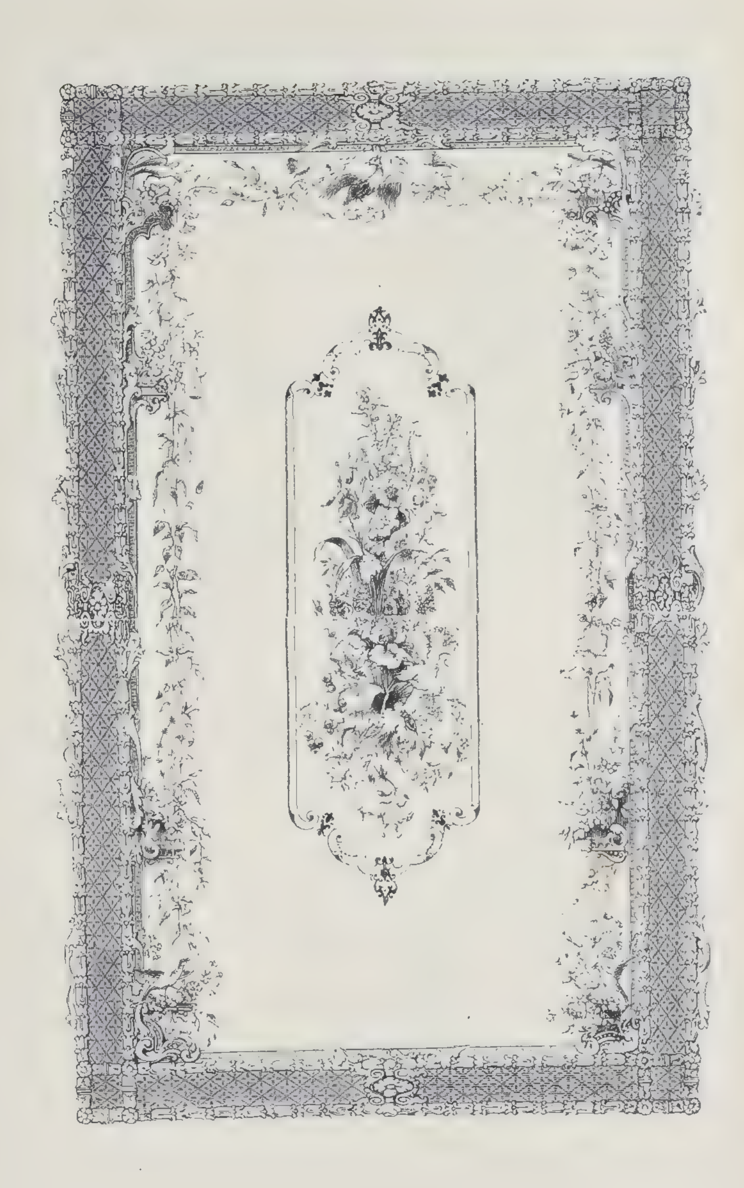
FRENCH AND ENGLISH ORNAMENTATION.

FOUR designs contrasting admirably with each other. The first, which is a top Border to a panel, is one of MM. Delecourt's beautiful examples of artistic papers: the vine and birds, in fact the whole composition is graceful in the extreme.

The second figure represents a Frieze in plaster, modelled by Mr. James Parker, jun., of London; the Cinque-cento scroll and the studies of wild flowers, wheat-ears, fruit, &c., are combined with much taste and skill.

The third and fourth charming examples are by Mr. Muckley, Master of the Burslem School of Art.





FRENCH AND SCOTCH DECORATIONS.

THE Panel is one of the many delicate examples of *papier peint* contributed by MM. Delicourt & Co., one of the famous manufacturers of such beautiful work in Paris, whose reputation is as well established in this country as in his own; the exquisite delicacy of the designs of these and other artistic hangings, the harmonious selection of colours, and the perfection of workmanship can scarcely be surpassed; there is but one real objection to their use in an artistic point of view—like pictorial carpets, they often destroy the effects of furniture and dresses.

The other engraving represents a chaste and effective design in the best Italian style, for the decoration of a saloon, shown by Messrs. Lithgow and Purdie, of Edinburgh, at the Great Exhibition of 1851. The ornaments are illustrative of the Seasons.



ENGLISH PAPIER-MÂCHÉ.

FIVE admirable examples of the application of papier-mâché to the interior ornamentation of houses and of furniture. The three specimens towards the left hand are by Mr. Bielefield, who acquired a well-deserved reputation long since for the application of this and other similar materials to architectural ornamentation; they are admirably modelled, and that in the centre is peculiarly light and elegant.

The two oval works are by Messrs. George Jackson and Son, of London, and are remarkable for the boldness and success of the designs; the upper example represents dogs fighting near a heron's nest, the other a dog attacking a duck's nest.



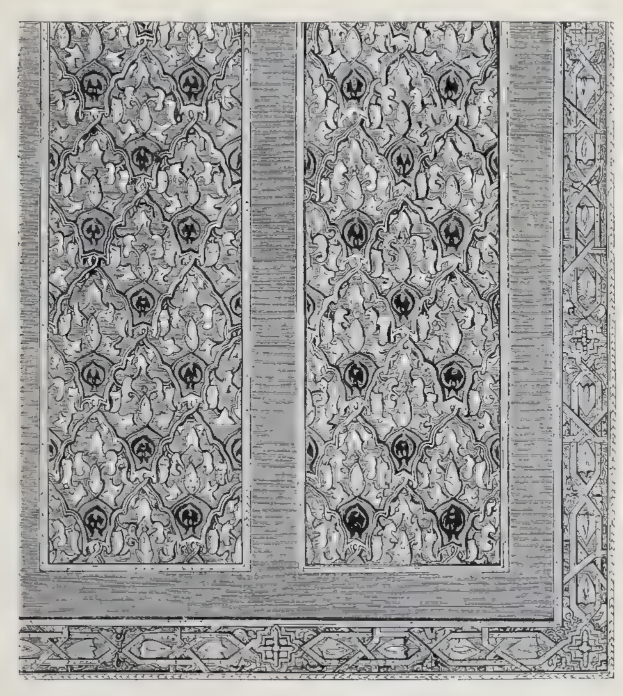


FRENCH TAPESTRY.

THE beautiful oval figure above represents a group of flowers from a piece of Beauvais Tapestry, contributed to the Dublin Exhibition of 1853: like the Gobelins and Sèvres, the Beauvais factory is a State establishment, and produces most beautiful work principally for furniture, and its most decided speciality is flowers, which the able workmen have learned to delineate in fine wools in such a manner as almost to deceive the eye. Whether the production of such costly works as these tapestries has any real Art value may be a question, but as furnishing hints to the dyer and to all interested in the harmony of colours they are almost invaluable.

The other example is the production of M. Moureeau, of Paris, who exhibited this and many other beautiful specimens of his workmanship at the Exhibition of 1867. His tapestries, like those of the State factory of Beauvais, are principally for furnishing purposes, and he has achieved great success, especially in flowers and in light fanciful subjects like that here given.

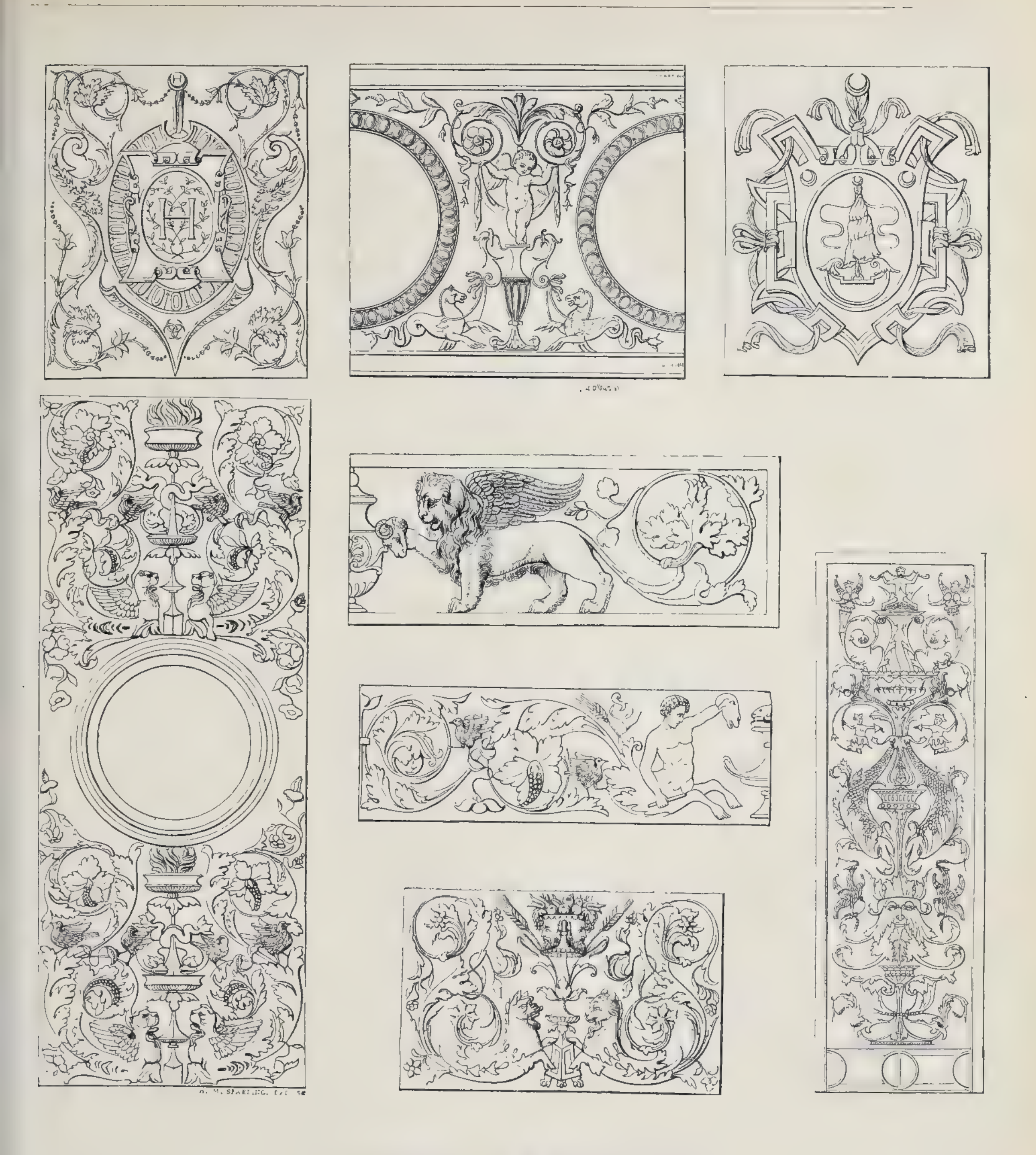






ENGLISH PAPER-HANGINGS.

ADMIRABLE examples of designs in Paper-hangings exhibited in 1851 by Messrs. Woollams, of London. Here are three styles totally unlike each other, but each studied and executed with knowledge, feeling, and skill; the panel towards the right hand is a charming adaptation of the Italian style of the best period, which has certainly never been surpassed, if it has been equalled; the square above, on the other hand, is an exceedingly good rendering of the brilliant Persian style; the third example reflects the beautiful ornamentation of the Alhambra, rendered famous in our country by the labours of the late lamented Owen Jones. We cannot imagine a better exercise for a young decorative artist than the reproduction, as a study, of these three charming designs, and colouring each as far as possible in the style of the artists of the period which gave rise to them.



ORNAMENTS FROM VERSAILLES.

SELECTIONS from a series of ancient, Mediæval, and Renaissance ornamental casts, in plaster, collected by, and arranged on the walls of Marlborough House (in 1854) under the superintendence of, Mr. R. N. Wornum. The Renaissance casts were copied from the best examples to be found in Italy, chiefly from Brescia and Venice; and, in order to render them matters of instruction to the student, as well as objects of interest, Mr. Wornum prepared a catalogue, containing a vast amount of descriptive information relating to the edifices from which they are taken and the artists engaged upon them; and the catalogue is enriched with a large number of well-executed engravings of the objects. The above are a few examples of the illustrations, from the wood-blocks used in the work. The characteristics of these Renaissance styles, ranging between the fourteenth and sixteenth centuries, and, with some varieties, to the seventeenth century, are brought forward in all their diversity; for Mr. Wornum, as well as every other student of Ornamental Art, divides the Renaissance, properly a general term, into the several periods of the *Tre-cento*, the *Quattro-cento*, the *Henri-Quatre*, the *Elizabethan*, the *Cinque-cento*—its perfect form—and the *Louis-Quatorze*. The ornamentist will find Mr. Wornum's catalogue a most useful book of reference.

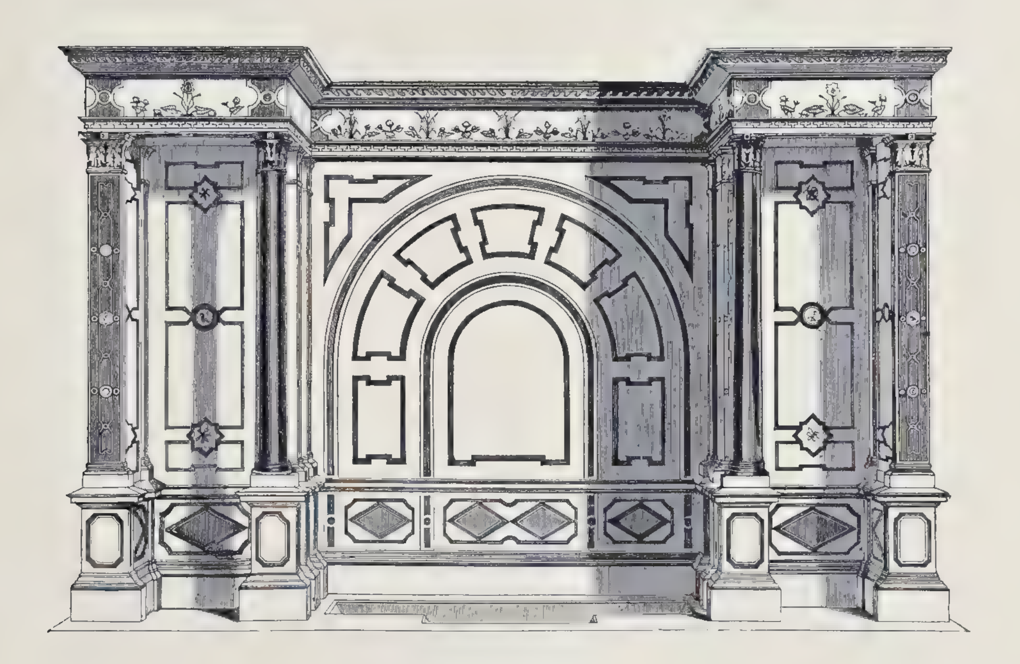


FRENCH MARBLE WORK, Etc.

A superb Chimney-piece, with Fender, exhibited by MM. Lesolle Frères, of Paris, in 1855: there is perhaps a superabundance of ornamentation, but the skill with which the whole is composed is very remarkable. As a decorative design the engraving is valuable, as it presents many points of originality, but the beauty of the work cannot be fully understood from it. This grand chimney-piece, designed for a ducal mansion, is composed of several materials of the choicest kind; the groundwork is of white marble, some of the mouldings are of ormolu, and the group of cupidons which surmounts the whole and the caryatides are of bronze; red marble is also introduced below, near the fire.

The upper portion of the page gives the opportunity of introducing part of a carved Looking-glass Frame by Messrs. Gillow, of London, in a chaste and very pleasing style, and contrasting curiously with its grand companion.





ENGLISH MARBLE AND SLATE.

THE Marble Chimney-piece above is the production of Messrs. Joseph Browne & Co. of London. Designs for such works are liable to run into the conventional, which become tiresome to the eye, while any serious departure from accepted forms is difficult: in this case the designer has been happy enough to hit upon a pleasing variation in the disposition of his decoration.

The other figure represents a manufacture of a most durable and elegant kind, peculiar to this country,—named Enamelled Slate; it is the side of a bath room, the bath itself being sunk in the floor in the middle, and the wings of the structure, which is on a large scale, projecting sufficiently to form screens. The Italian style selected is simple and well suited to the purpose, and the slate is enamelled in imitation of rare and beautiful marbles. It is by Mr. Magnus, of London, who has produced much good work of this kind.

Both these objects were exhibited in 1851.



ENGLISH DECORATIVE WORK.

THE sculptured Chimney-piece here engraved was the last work of a sculptor of eminence, John Thomas, who had not quite finished it when he died; the subjects are from "Midsummer Night's Dream." The elegant Stove is by Messrs. Stuart and Smith, of Sheffield. Exhibited in 1862.

The Panel just above the chimney-piece, which exigency of space has caused to be laid on its side instead of vertically, as it should be regarded, is a remarkably bold and well-executed piece of ornament in the Italian style, executed in papier-mâché or *carton-pierre* by Messrs. Jackson and Sons, of London, and shown in 1851.

Above this again is an elegant ornament to surmount a door, an "Over-door," as it is called, executed by Messrs. White and Parlby in a composition composed of a mixture of clay and papier-mâché, much employed by them; shown in 1862.

Lastly, the small figures to the right and left represent two Panels in artistically decorated paper-hanging, for which Paris has a well-earned reputation; they were exhibited by M. Hoock in 1867.

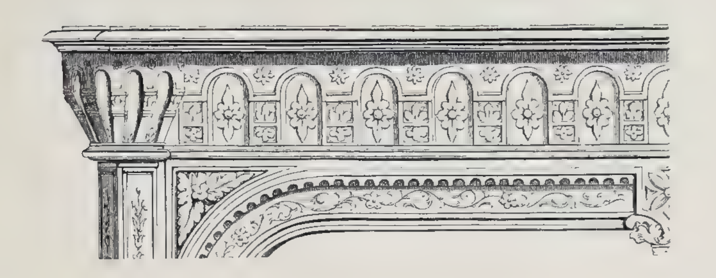


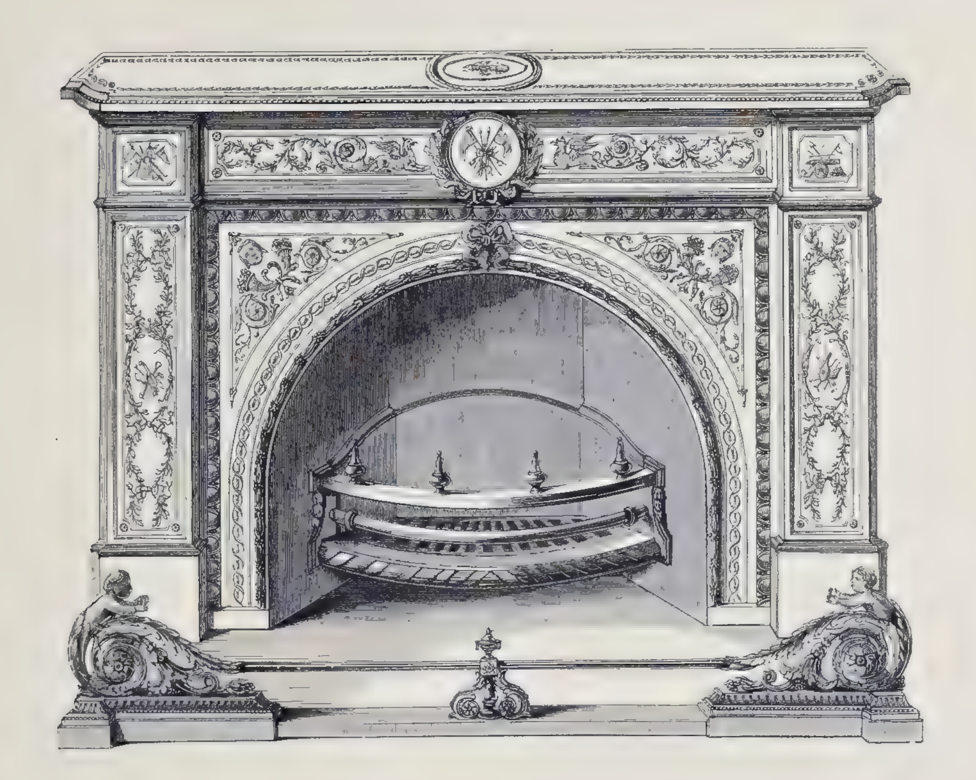


ENGLISH AND ITALIAN MARBLE WORK.

THE lower figure represents a noble Chimney-piece, executed by Mr. Thomas—who did a large portion of the modelling of the ornamental work of the Palace at Westminster and of the sculpture that decorates it—for Preston Hall, the seat of Mr. E. L. Betts: the two charming figures are those of Chaucer's heroines, Dorigine and Griselda, and by the side of each is a bas-relief representing incidents in the poems; the portrait-bust which occupies the central place is that of the father of English poetry himself.

The smaller example is the work of an Italian artist, Signor Conte, long resident in London: it is remarkable at once for originality, simplicity, and elegance. We hope to give other proofs of Signor Conte's taste and skill.





ENGLISH AND FRENCH DECORATIVE WORK.

A BEAUTIFUL Drawing-room Stove, with chimney-piece complete, exhibited by Messrs. Feetham, of London, at the Paris Exhibition of 1855. It is composed of painted china slabs with ormolu mountings: the ornamentation is of a very delicate kind, and executed with much skill. English works of this class have assumed a very important character of late years, and it is satisfactory to note that improved taste has gone hand-in-hand with perfection of workmanship. Messrs. Feetham have long been prominent amongst the best producers of such elegant decorations for our drawing-rooms.

We take advantage of the space above for a portion of a Gothic Chimney-piece, treated in a peculiarly chaste manner by M. Lebrun, of Paris.



ENGLISH AND BELGIAN DECORATIVE WORK.

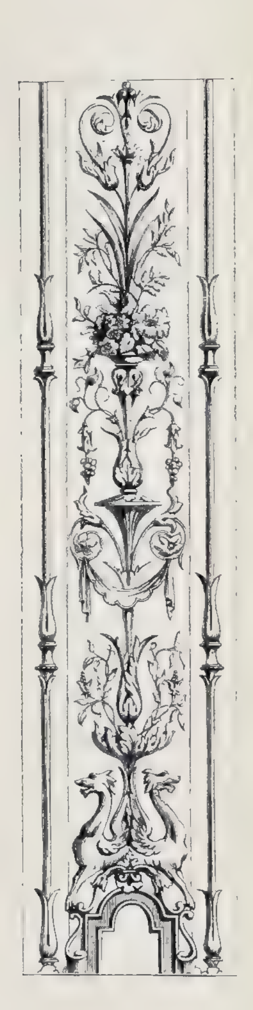
A SUPERB Drawing-room Grate by Messrs. Yates, Haywood & Co., of Rotherham, designed, we are informed, by Mr. George Wright, an artist attached to the establishment. The stove is composed of steel brilliantly polished, with ormolu mouldings and other ornaments. It will be perceived that there is no fender, its place being occupied by a raised hearth with decorated moulding; but in place of the former is a pair of handsome fire-dogs, formed of foliage, amidst which are charming figures of shepherds and wood-nymphs. The fire-dogs are connected by an elegant ornamental piece, which conceals an opening in the hearth that slopes downwards behind this ornament, and allows of the escape and concealment of the ashes and cinders. The stove is set in a handsome white marble chimney-piece, but it is to be regretted that some other ornament should not have been chosen in place of a bunch of marble fruit, tied by means of a ribbon to the solid marble of the structure.

We find room above for an elegant piece of sculptured work, the top of a Mantelpiece, by M. A. Leclerc, of Brussels, an accomplished artist.









FRENCH PAPER, ENGLISH DECORATION, Etc.

THE elegant Corner-piece above is from one of M. Delicourt's (of Paris) charming panelled paper-hangings. These elaborately decorated paper-hangings, or *papiers peints*, as our neighbours well call them, are now in little request in France or England—a purer style has succeeded; but it is impossible not to admire the beauty of the designs and the perfect execution which distinguish the productions of M. Delicourt and other leading Paris firms. The difficulty and the cost which attend them may be estimated from the fact that in the most elaborate papers no less than fifteen hundred engraved blocks are required to produce a piece.

First of the three figures below is an extremely elegant specimen of Door Furniture by Mr. H. Maye, represented just half its real size.

The central figure represents a production by M. M. Latry, of Paris, in what is called *bois durci*, that is to say, sawdust treated in such a manner as to form a beautifully homogeneous substance capable of a high degree of ornamentation.

Lastly, the portion of a Decorative Panel by Messrs. Hinchliffe & Co., of London, presents a charming example of Raphaelesque ornamentation, than which nothing can be more elegant.

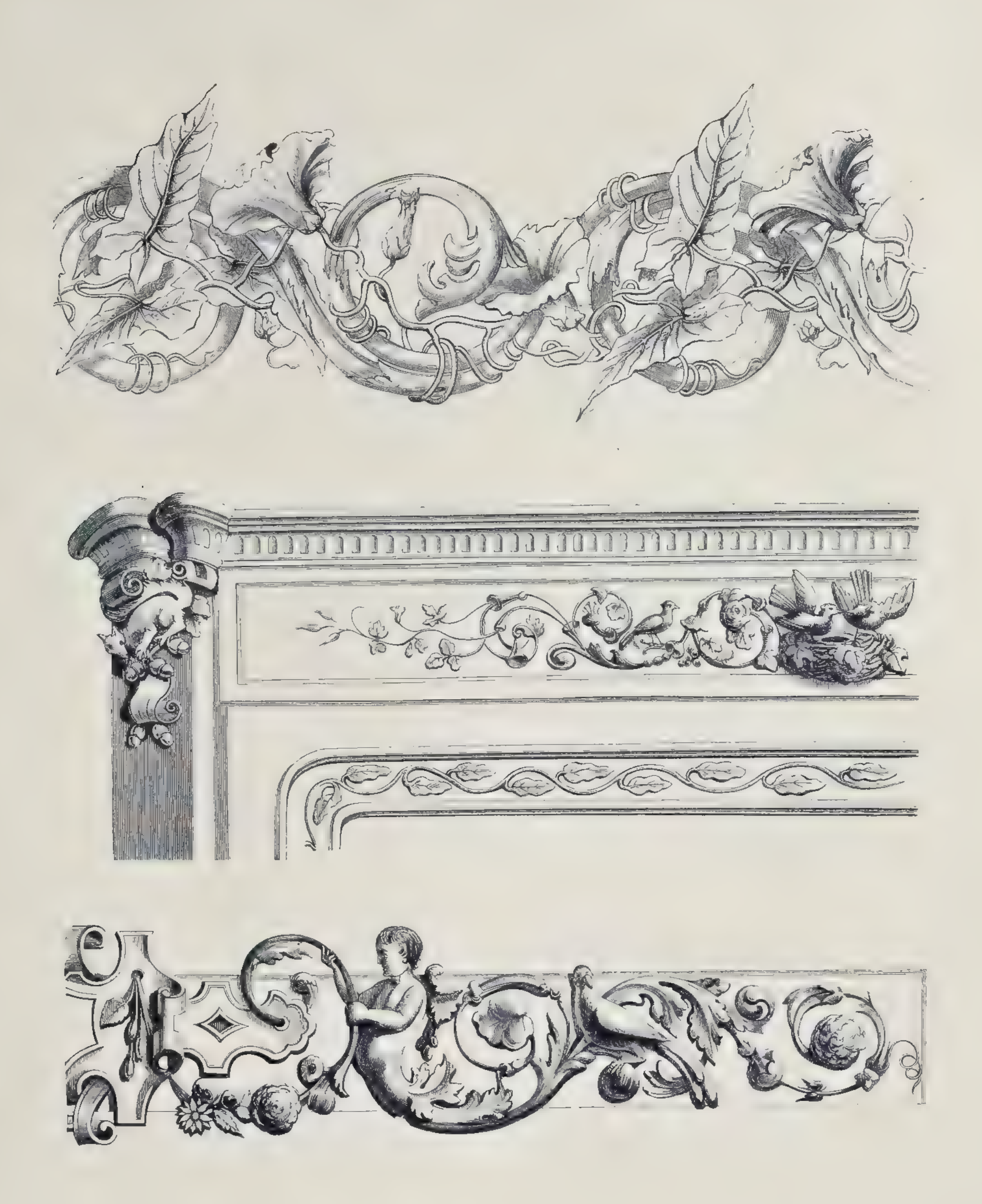




FRENCH AND BELGIAN DECORATIVE WORK.

THE upper figure represents a fanlight, *œil de bœuf*, or door ornament, by M. Cruchet, of Paris, and presents a fair example of Renaissance ornament.

The marble Chimney-piece below is a specimen of the work of one of the most eminent decorative sculptors of Brussels, M. Leclerq. The richness of this work speaks for itself, but the symmetry of the various parts and the beauty of the mouldings call for special notice. This remarkable specimen of ornate marble work was exhibited here in the year 1862, the date which we now enter upon. Nearly all the previous examples belong to the first half of the century.



ENGLISH AND FRENCH ORNAMENT.

THE first of the three engravings here given represents a design for a Cornice Moulding by Mr. Leighton, who has made use of one of the commonest and prettiest of our garden flowers.

Beneath is a portion of a Marble Chimney-piece by M. Le Brun, *fils,* of Paris—an example of a very moderate amount of ornamentation judiciously applied.

The third example is half the Frieze Ornamentation of a chimney-piece by M. Roland, of Paris, who has followed the heterogeneous Cinque-cento style of scroll-work faithfully. It would be considered an impertinence, perhaps, to ask how the boy supports his equilibrium; and still more so, how he got the thick end of the scroll he holds in his hand through that small hole in the wing of the escutcheon.





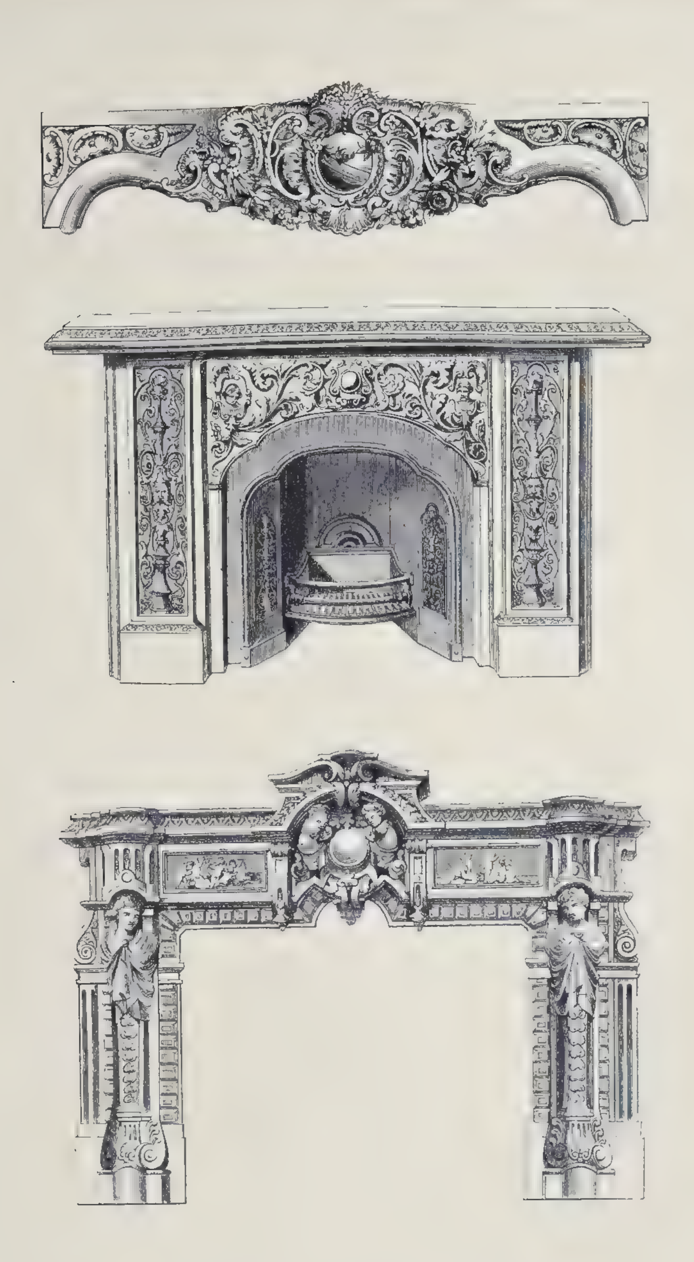
BEAUVAIS TAPESTRY.

THERE are few Art-manufactures which are so famous as French tapestry. Fine old examples of the Gobelins manufacture, when offered for sale, fetch as much money almost as the works of great painters: yet in spite of the general admiration, in spite of the fact that Raphael drew those glorious cartoons, so fortunately preserved and now so well exhibited in the South Kensington Museum, specially as patterns for tapestry, many persons object that true Art, and especially the human face, can never be rendered in wool or silk. The works before us are, however, not open to this objection. Beauvais, although a national manufactory, like the Gobelins establishment, confines itself to furniture tapestry, and deals not with figure-compositions and landscapes on a large scale, but with that which is essentially decorative only, and in this is unrivalled. The charming designs of flowers, fruit, scroll-work, the exquisite dyes, the harmonious selection of tints, and the perfection of workmanship are admitted by every one who has given any attention. The two beautiful examples here given were worked for the boudoir of the ex-Empress.



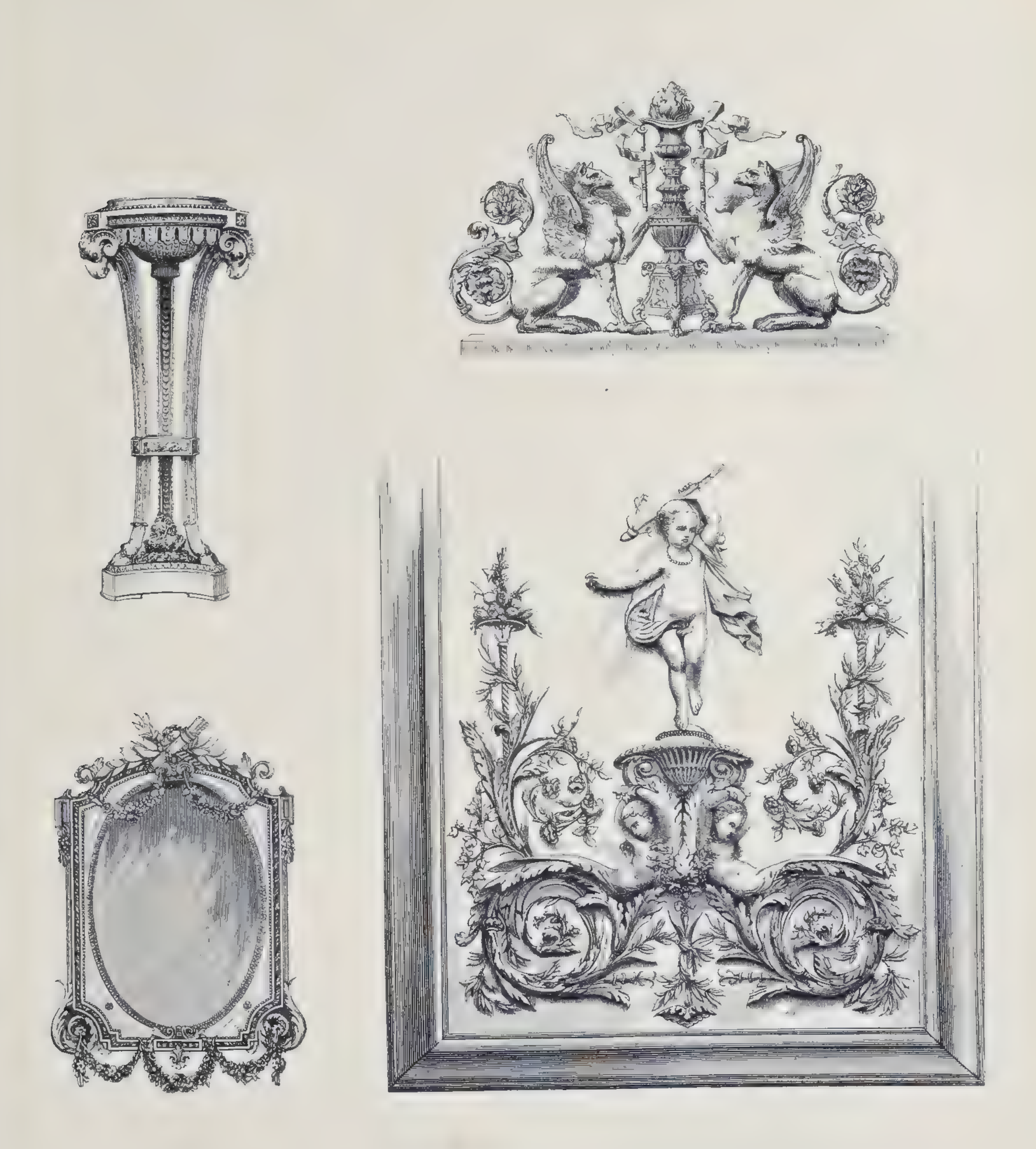
ENGLISH SCULPTURE AND DECORATIVE WORK.

A REMARKABLE example of the application of artistic knowledge and talent to decoration: a grand Fire-place and Glass-frame designed for the drawing-room of the town mansion of Sir Morton Peto, M.P., by the late sculptor John Thomas, in or about the year 1853, and executed by him or under his direction. The chimney-piece is in fine statuary marble, and the frame of the glass in white and gold. The carrying up of the pillars of the fire-place, so as to form plinths for the figures, connects the two portions of the work in a most effective manner. The figures themselves, indicative of science and the arts, are excellent, and the scrolls, and indeed all the ornamentation, are bold and masterly. Mr. Thomas supplied many beautiful designs for works of various kinds, and other evidences of his fine taste and skill will be found in this work. This fine work is worthy both of artist and patron.



ENGLISH CHIMNEY-PIECES.

TWO decorated Chimney-pieces and the top of a third, by Messrs. Collins and Green, of London, who seem to have made chimney-pieces, which they produce in all varieties, from the simplest to the most elaborate, their special object. The ornamentation and the workmanship are, however, generally of the best kind. The examples before us present great variety, and that below much originality and gracefulness. The chimney-piece of a large room is a very important object, and on its treatment much of the general effect of the apartment depends. Some of the most elaborate examples in ancient house decoration are what are called "monumental chimney-pieces;" such, for instance, as that in the old palace of the Dukes of Burgundy at Dijon, and others which have been often engraved and are well known to ornamentalists. These frequently occupy the entire end of a grand or lofty chamber, and include in some instances many life-sized figures in sculpture. In our modern houses the treatment is, of course, different; but in well-designed rooms we often now see the chimney-piece carried up to the ceiling, including within its plan looking-glass or picture, and niches or brackets for sculpture or lights.



ENGLISH CARTON-PIERRE AND PAPIER-MÂCHE.

FOUR admirable examples of the best English composition work for decorative purposes by Messrs. Jackson and Sons, of London, who have long supplied English architects and decorators with means for the highest class of decoration. The principal illustration is that of a wall treated in the style of Louis XVI., into the spirit of which the artist has entered most thoroughly; the grand scrolls below are peculiarly full and rich and somewhat novel in treatment, and the whole composition is very pleasing. The ornament above the preceding is described as a "Trophy executed for a City Company:" this is not a very clear description, but, as an example of ornament after the style of the Cinque-cento artists, it is certainly admirable. The two small objects which fill up this page are a Flower-stand and a Mirror, both in the Louis XVI. style, and both charming examples of its adaptation.



ENGLISH COMPOSITION ORNAMENTS.

THE six examples here given are by Mr. Bielefeld, of London, one of the largest and most successful producers of ornaments for builders and others. He has also produced numerous excellent special examples for the decoration of public buildings and private mansions. The composition is generally papier-mâché, but Mr. Bielefeld has also others, which he calls *siliceous fibre*, &c. The reading-room of the British Museum is lined with one of these. The engraving at top, and that immediately beneath it, represent portions of a magnificent cornice, specially designed for a music hall; the bays between the trusses are filled in alternately, as here shown, with the figure playing the lyre and scroll-work, and with medallion heads of great composers within wreaths, like that of Mendelssohn here given. The scrolls, flowers, &c., in these and other productions by Mr. Bielefeld are admirably designed and executed, and offer excellent opportunities of ornamentation, not only to builders, but to many manufacturers, at a comparatively trifling cost. Young Art-workmen and designers should, however, most carefully avoid the glaring error of over-ornamentation, which is infinitely worse than plainness.



ENGLISH WALL-PAINTING.

A CHARMING example of Arabesque decoration for the wall of a drawing-room, designed and executed in oil-colours by Mr. Coulton, of London. The style is that of Louis XVI. The composition in the central panel represents Mercury presenting the caduceus to the Goddess of Peace, who crowns the messenger of Olympus with a laurel wreath, while she herself partly conceals the implements of war; the idea is continued by the reproduction of the caduceus as the central object in the frieze above, with arms and the torch of war in the rear. The scrolls which flow from this central ornament are very graceful. The side panels are very pleasing reproductions of the ornamentation common in France. The emblems introduced in one panel are those of painting and music, and in the other, of sculpture and the sciences; in the angles of the frieze are implements of husbandry and industrial tools.



ENGLISH CEILING DECORATION.

PORTION of an admirably designed Drawing-room Ceiling, the right-hand panel and circular corners being omitted for want of space. The chief subject may be indicated by Byron's lines—

> "The morn is up again, the rosy morn,
> With breath all incense and with cheek all bloom,
> Laughing the clouds away with playful scorn."

The four seasons are symbolized by the medallions in the corners. The whole work is marked by much taste and skill. It was designed and executed by Messrs. Purdie, Cowtan & Co., of London.



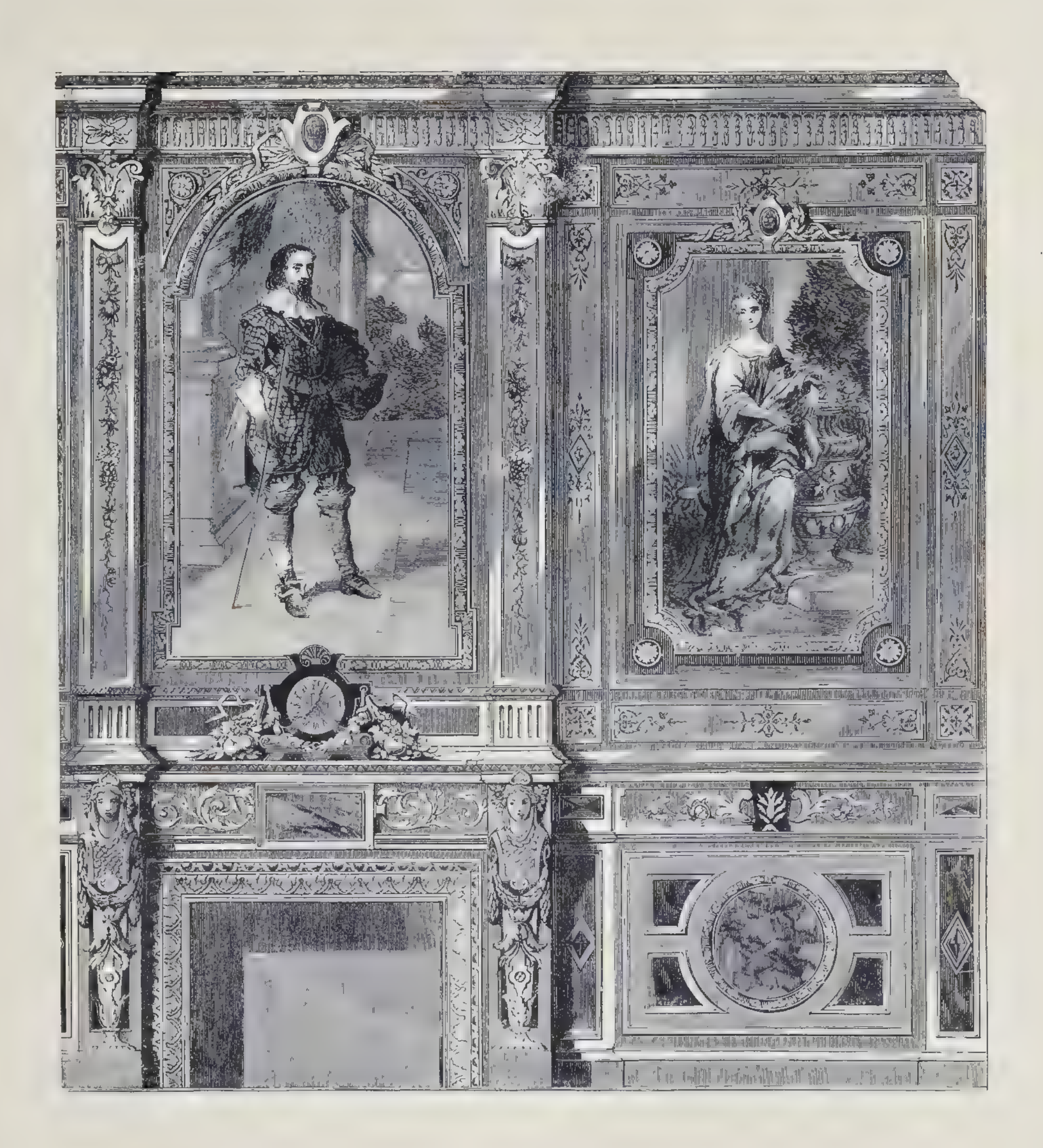


ENGLISH AND FRENCH DECORATIVE WORK.

TWO works, both remarkably beautiful, yet so utterly dissimilar in feeling and style as to present the most curious contrast.

The first is the production of Messrs. Wright and Mansfield, of London, and is designed *en suite* with a beautiful dwarf bookcase in the English style of the eighteenth century, already given in our pages. Like the former, the foundation of the work is of *gean*, or wild cherry wood, with ebony and plaques of Wedgwood ware; ebony is used for the colonnettes and details in relief, and here and there gold is introduced with great taste. The carving is of the most delicate description. The grate and fender are designed in keeping, and admirably executed by Messrs. Feetham, also of London.

The other Chimney-piece is one of the charming productions of M. Fourdinois, of Paris. It is a work teeming with knowledge and skill, and the carving is hardly to be surpassed, especially in the case of the two beautiful figures which form the chief elements of the decoration; here the chase is the subject illustrated. We have animals introduced here and there, and the large oval panel is occupied, not by masses of "still life," but by a group all life and animation—a peep at the field, not the larder.



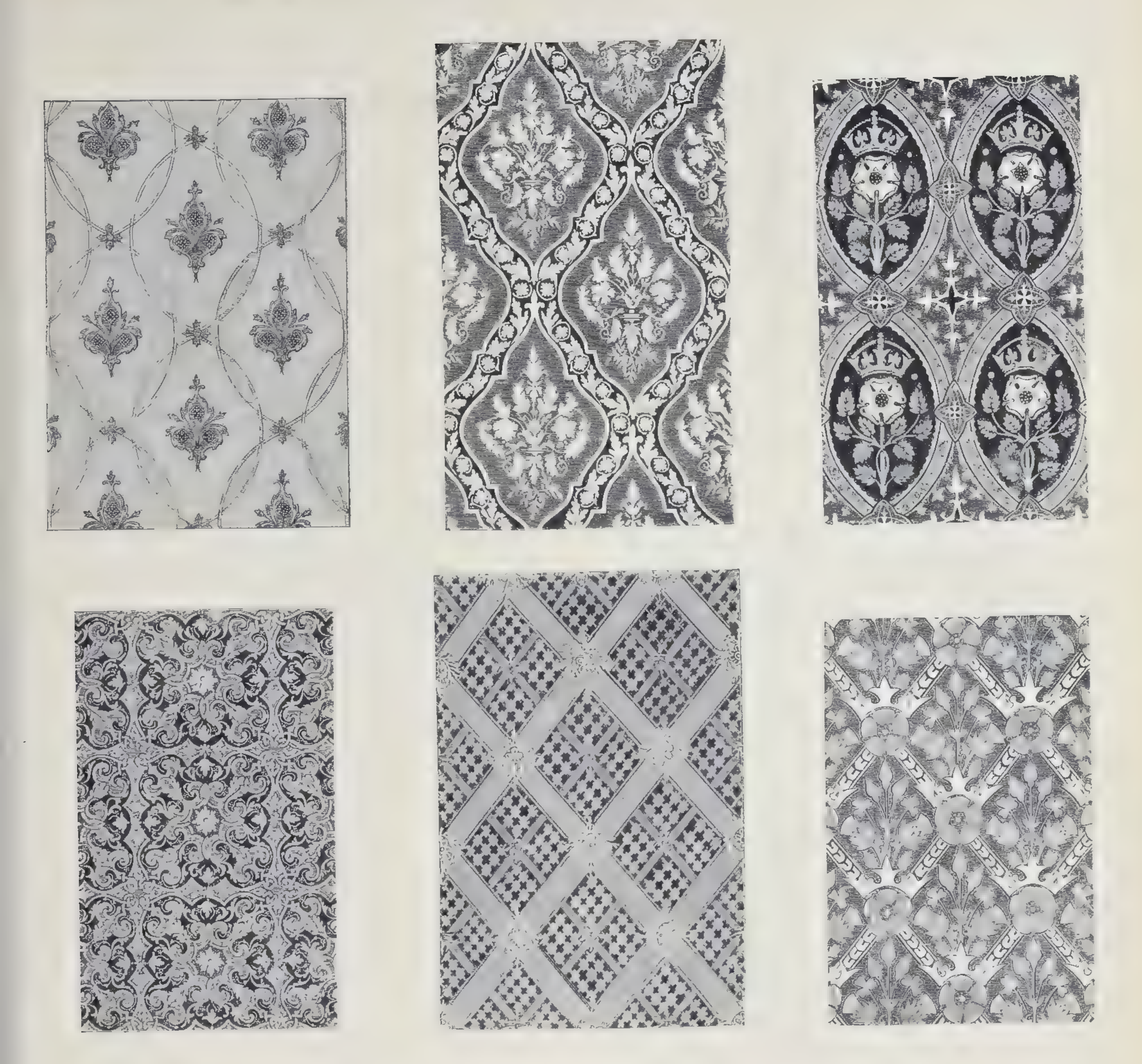
ENGLISH MURAL DECORATION.

A SPECIMEN of Room Decoration by Messrs. Purdie, Cowtan & Co., of London, expressly designed to show the application of High Art to wall decoration. The wall treated is that of a dining-room, and, although our illustration is incomplete, the second panel being omitted for want of space, it will be seen that these eminent decorators—other specimens of whose work will be found amongst our illustrations—have been highly successful in their aim. The artist has adapted the Renaissance with great skill, and has succeeded in producing a most pleasing design, full of beauty, yet not in any way overladen—solid and elegant.



SCOTCH DECORATIVE WORK.

THE central panel with one of the two doors forming the side of a drawing-room, twenty-five feet long and seventeen feet high, by Messrs. Purdie, Bonnar, and Carfrae, of Edinburgh. The designer, Mr. Bonnar, who also painted the principal figures and medallions, has selected the style of the Italian Renaissance of the best period. The semicircular panels which surmount the doors are filled with groups of cupidons emblematical of Painting and Music; the two cameo heads on the narrow panels represent Spring and Autumn; and the elliptical panels in the spandrels above are decorated with fancy heads painted, as are the groups of cupidons, in natural colours, while the cameo heads are in white upon a purple-tinted ground. The mouldings and ornamental portions of the panels are in gold, partly burnished and partly matted. All the framework enclosing the mirror and side compartments is painted in delicate shades of Sienna marble.

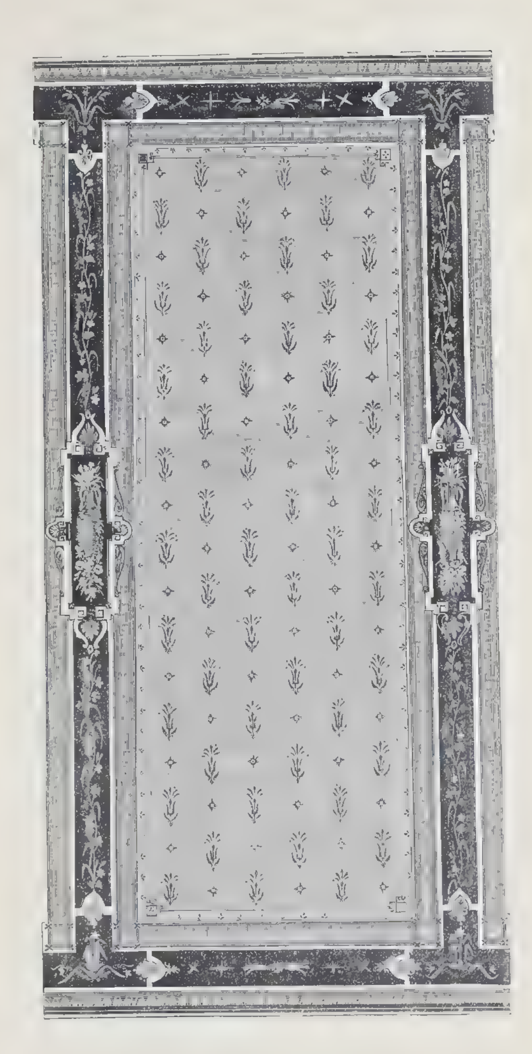


LEATHER-CLOTH AND PAPER-HANGINGS.

THE town of Cordova, in Spain, was one of the most celebrated places in Europe for fine leather, and amongst the forms in which it was introduced into decoration was that of decorated hangings; the skins were embossed separately, the patterns selected were very bold and effective and the gilding and colours brilliant, but the cost was very high. The Cordova hangings are now of great value, fetching large prices whenever they appear for sale. The two examples which occupy the two places to the left-hand of this page are modern imitations of the Cordova leather, in what is called leather-cloth, by a company which has works at West Ham, and also in France and Belgium; the foundation being a woven tissue, can of course be had of almost any width or length required, and thus the embossing, printing, and gilding can all be performed in the same manner, or nearly so, as in the case of calico, table-covers, &c. One great point is to obtain a perfect leather-looking surface, and this is achieved; the second is to select such designs as shall be suitable to the purpose in view, and in this also the Company has been successful; the two small examples here given will serve to draw attention to this manufacture.

The other examples are of Wall-papers of the best class, the patterns of which are all perfectly in unison with the true taste now prevailing, which demands that the paper-hangings shall serve as a background to, and not come into competition with, the contents of the room. The two in the centre are by Messrs. Turner and Owst, and the two towards the right-hand by Messrs. Cuthbertson & Co., both of London.

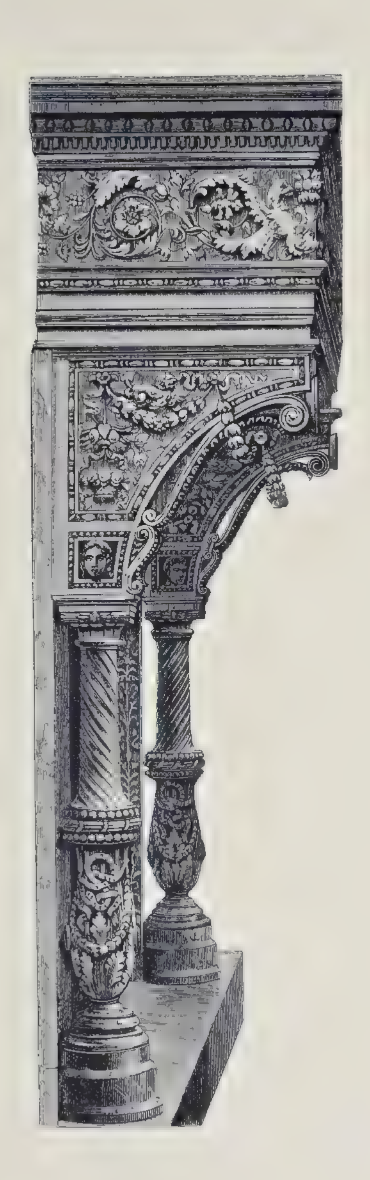




FRENCH AND ENGLISH DECORATION.

THE first of our engravings in this page represents an elaborate and most effective work in coloured marbles, bronze, and ormolu, by M. Marchand, of Paris. Of course much of the beauty of such a work depends upon the selection of the various coloured materials; but the way in which the beautiful ancient types are employed must delight every practised eye. It was regarded, and deservedly so, as one of the most admirable works of its kind at the Exhibition of 1862.

The other portion of the page is occupied by a production of much less pretension, but, in its way, admirable: it is a Wall-paper in the Pompeian style, by Messrs. W. Woollams & Co., of London. Every portion of the work is delicate and harmonious, and the ornamentation is just of the class which is most suitable for wall decoration, not rivalling the works of Art or the furniture of an apartment, and such as the eye may rest upon without the fatigue which is the natural result of gaudiness.





ITALIAN SCULPTURED WORK.

THE engraving which occupies the place on our left hand represents a portion of one of the most celebrated pieces of decorated work of the class that we know of—the famous fireplace of the Doge in the Palace at Venice, the work of Giovanni Zamolo. The whole work is full of beauty; but, in our estimation, the scroll-work in the frieze is pre-eminently graceful.

The companion work is also Italian, but of our own period, the production of Signor Rosetti, the sculptor of Milan, who contributed beautiful works of Art, of which we may mention a charming seated female figure, semi-nude, watching a pair of doves billing and cooing at her feet, to the Italian Court of the Paris International Exhibition of 1867. The design is decidedly original, and every portion of the sculpture is executed with consummate taste and skill. If the Italians have now no Michael Angelo, they still retain marvellous fancy and skill in detail and finish, and present us with many exquisite examples of decorative work of many kinds.







FRENCH TAPESTRY.

WHEN we look at one of these marvellous productions in dyed wools, we are somehow always reminded of the works of the Oriental nations; here, in Europe, where production in general has become remarkable for its celerity, we still see, we may almost say, a race of men devoting their lives to forming what may be called wool mosaics for tapestry is neither woven nor embroidered by needle or shuttle, but each atom of wool is laid in its place by hand and eye, the shuttle merely coming into play to lay the weft and complete the foundation—which occupy years in production, while the drawing, the really artistic portion of the work, perhaps did not occupy a month. The success achieved is certainly marvellous, and when the design is suitable to the material, fine tapestry work is almost a picture. The beautiful example before us is by one of the most eminent manufacturers, MM. Requillart, Roussel, and Chocquerel, of Paris.

The two beautiful pieces of tapestry for Chair Seats, in the Beauvais style, are the work of M. H. Mourceau, of whose productions we give other examples.

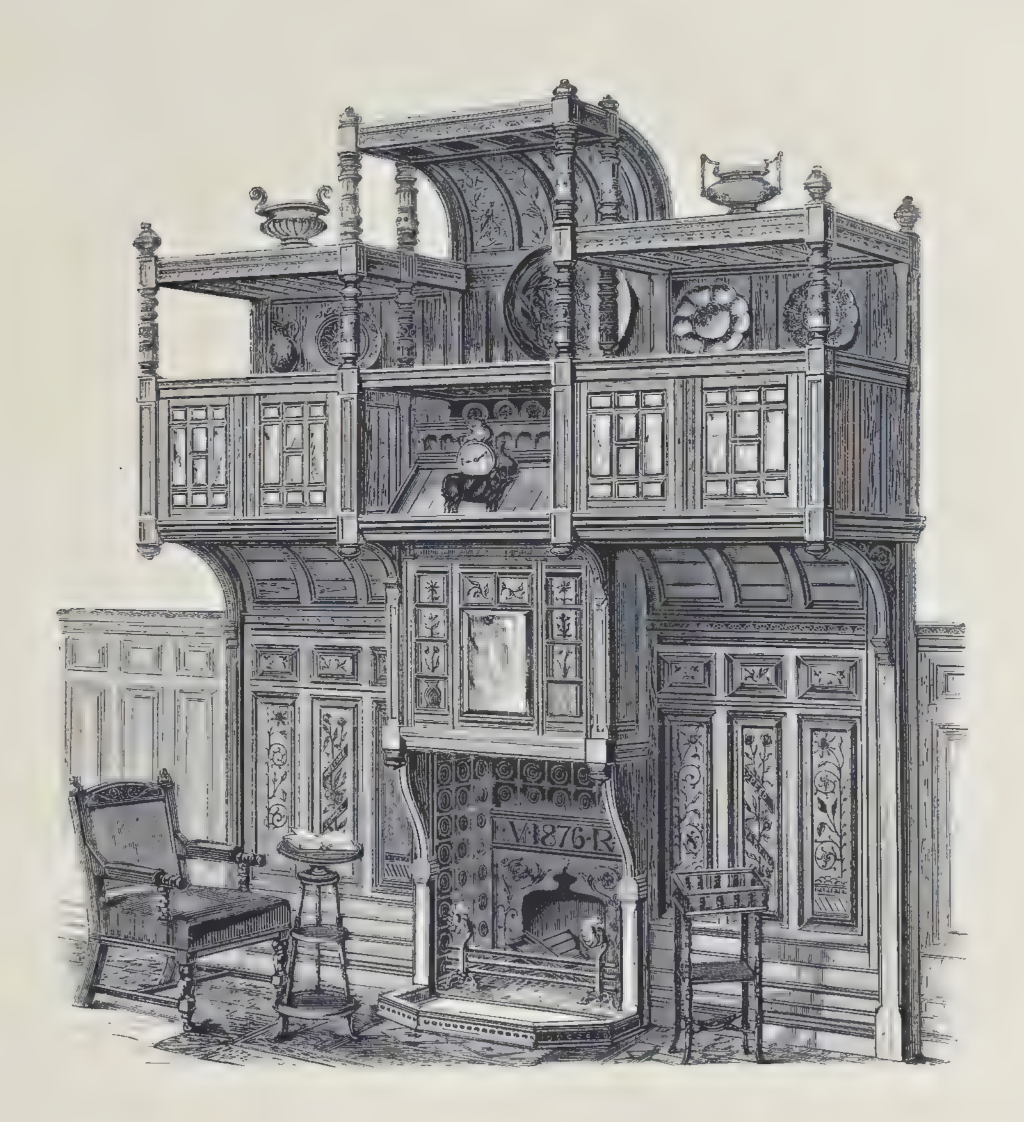


FRENCH DECORATION AND FURNITURE.

DESIGN for decoration and furnishing the end of a room by a celebrated French artist, M. Eugène Prignot. The walls are adorned with caryatides and *cupidon* mouldings; the ceiling supported by trusses in relief, formed of *carton-pierre*, and enriched with arabesques in colour; an elaborate cabinet in ebony, richly sculptured, and inlaid with marbles of sober but rich tone; and sculptured pedestals surmounted with marble busts. The effect of the whole is undoubtedly harmonious and pleasing, full of suggestive hints to the decorative artist.

On the subject of decoration it has been remarked by an authority in matters of decorative taste, that "unless the province of the decorator and of the cabinet-maker are to a great extent incorporated, there is every likelihood, instead of the labours of the former being subordinated to the latter, that the effect of the most elaborate furniture will be overpowered by the greater brilliancy of the walls and ceilings; while, on the other hand, should the decoration be really a work of Art, unless the cabinet-maker or upholsterer be a man of taste and self-denial, his marqueterie and inlays, and his florid carpets and curtains, will reduce the painter's work to comparative insipidity." It would be distasteful and useless to dwell upon the numberless illustrations we see around us of the violation of all the rules of decorative Art, and nowhere more glaringly than in the houses of those who possess large means. We prefer to call especial attention to this illustration as an example of decoration and furniture combined, exhibiting great harmony and beauty.

We avail ourselves of the space towards the left hand to introduce a good example of arabesque ornamentation from a wall-paper by Messrs. Scott, Cuthbertson & Co., of Chelsea.



ENGLISH MEDIÆVAL WOODWORK.

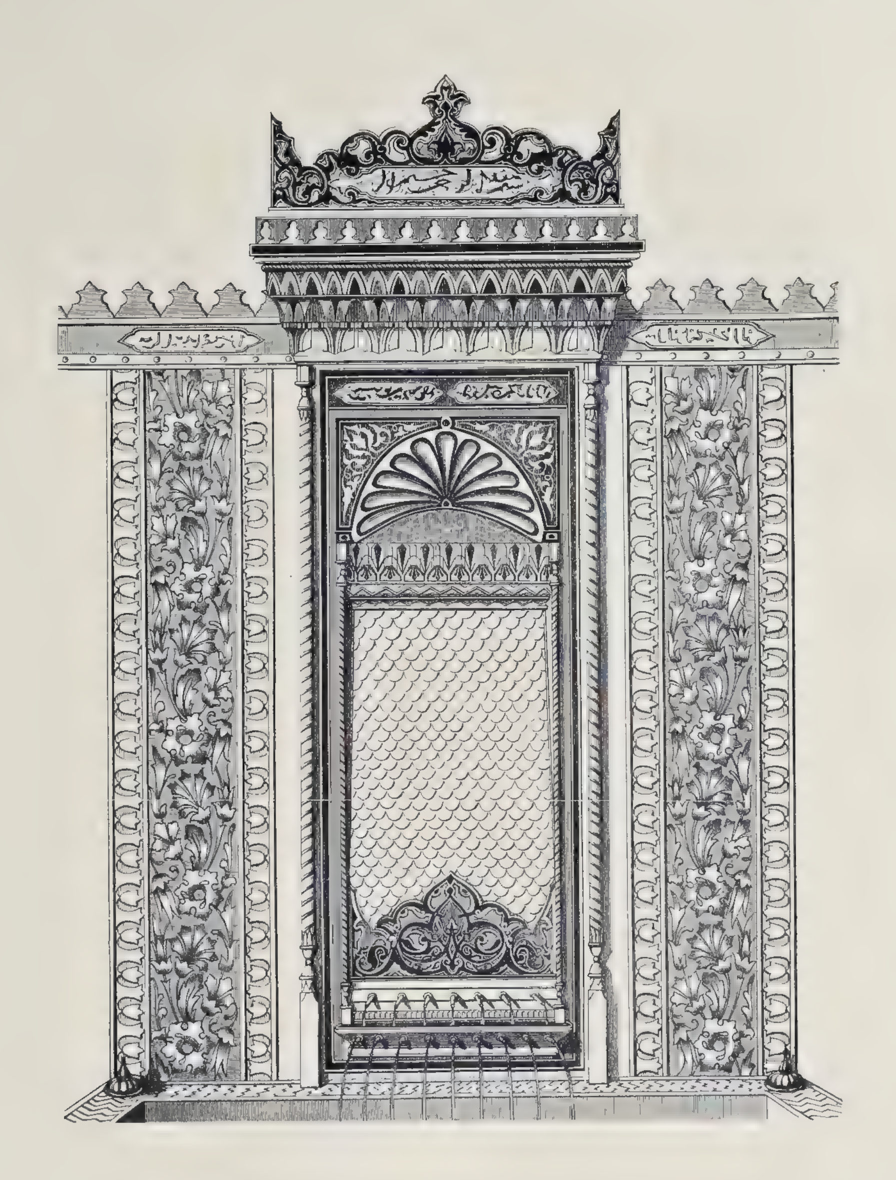
AMONGST the contributions of British Art-manufacturers at the Philadelphia Exhibition were several which stood out prominently and bore witness to the amount of taste as well as skill now lavished on our furniture and fittings. The Chimneypiece and Wainscoting which are here engraved are the productions of Messrs. Howard and Sons, of London, who with an admirable adaptation of an old style have combined the application of a process for inlaying solid wood with any other kind of wood according to any design, a process of great value for interior decoration, as it gives all the effect of inlaid veneers—and may, by the adoption of carving with the inlaying, far surpass it—with as much durability as the piece of furniture so decorated, or the wood itself, is capable of.



ENGLISH MOSAIC PAVEMENT.

MOSAICS of themselves do not enter into the programme of this division of our work; but the material does not always determine the place of a thing—the application has to be considered, and therefore we conclude this section of our work with a few examples of the application of ceramics to the decoration of buildings.

The first example which we select is a Mosaic Pavement by Messrs. Minton, Hollins & Co., who have produced a beautiful work, the design of which is well shown in the accompanying engraving; this Mosaic is in small pieces, "tesseræ," of which there are about 150,000—the classic head in the centre contains upwards of 8,000. The young decorative artist should also make himself acquainted with the other forms of mosaic which have been introduced of late, of a more simple and less costly character than this elaborately beautiful pavement, which may be seen to advantage at the South Kensington Museum and other public establishments, and not unfrequently now in the halls and passages of private houses; besides this kind of work there is a still cheaper and bolder style in which simple geometric patterns are produced for floors and walls in variously tinted and shaped tile or brick. When well burnt there is nothing so suitable to our climate as this terra-cotta work.



FRENCH FAIENCE.

IN the Paris Exhibition of 1867, a compartment was filled with a number of large works in decorated earthenware, by MM. Collinot & Co., of Paris, which attracted well-deserved attention. Faïence or Fayence, the name being most probably derived from the town of Faenza, where the Italians first manufactured ornamental ware of the Majolica class, invented, it is believed, by the Arabs, has been cultivated with great success in France, and by none more than the firm above named, the originator of which, M. de Beaumont, was an artist of great ability. The beautiful mural fountain here represented, it is hardly necessary to say, is, like many other works by M. Collinot, composed in the Persian style, and the result is a most graceful production. The engraving does justice to the forms of the ornamentation, but leaves the colouring, in which French artists are adepts, to imagination. Besides the higher artistic qualities, this firm has shown great skill in producing such large slabs as are here used almost perfect in form.



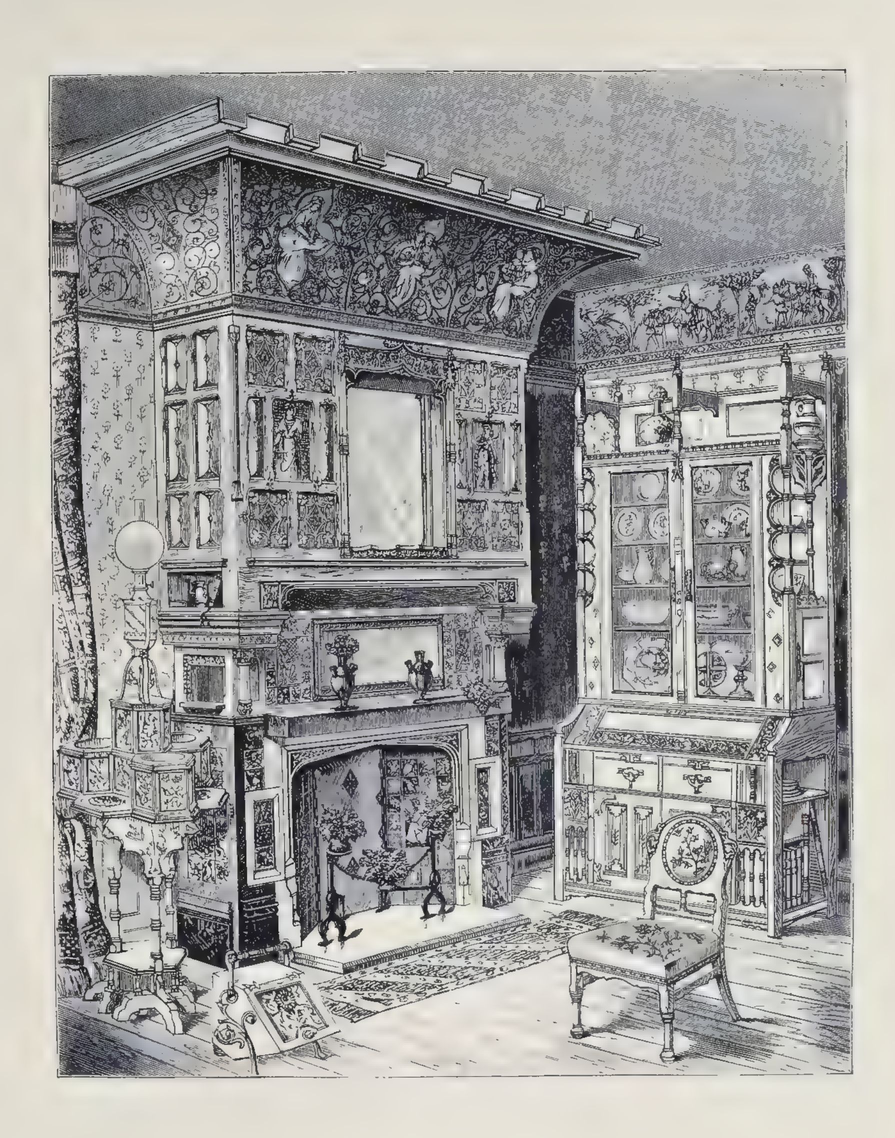
ENGLISH CHIMNEY-PIECE.

DECORATED Chimney-piece shown at the Vienna Exhibition, 1873, by Messrs. Simpson and Sons, of London. This fine example of ornamental fitting is about eight feet in height, constructed of walnut-wood and set with painted tiles. It is arranged in three stories: the projecting bracket in the middle, at top, is intended for a clock; in the centre, just above the mantel-shelf, is a mirror with bevelled edges, in the Venetian style, and the sides of both upper shelves are brought forward and supported by turned pillars to form recesses for the display of china or other objects of Art. The tiles are painted with great care by eminent artists, the subjects being fables, such as "The Fowler and the Heron," "The Lion and the Birds." The style of the work is English, of the seventeenth century. This beautiful Chimney-piece was set up in the saloon of the British Commission, and was purchased by H.R.H. the Prince of Wales.



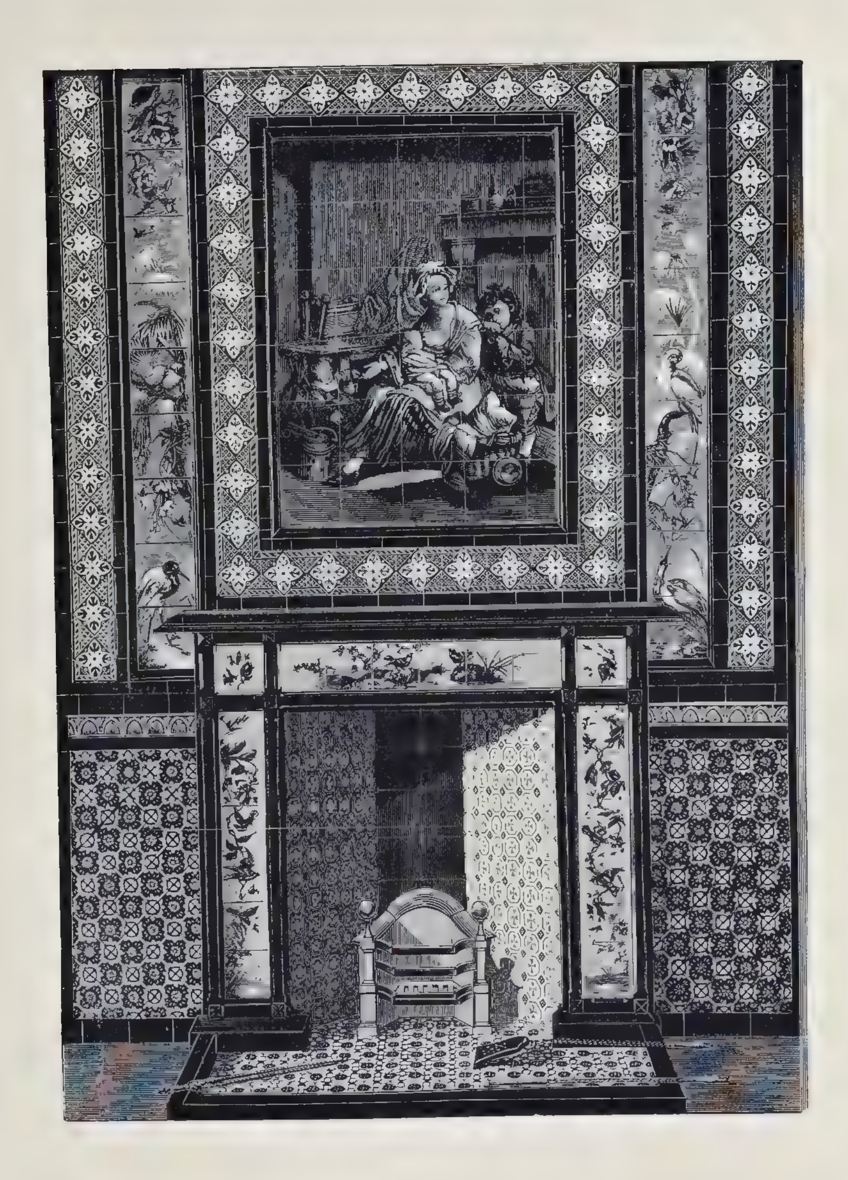
LONDON LATE ENGLISH WORK.

THE admirable work which occupies this page deserves the careful study of students and Art-workmen: it is designed by a practised hand, that of Mr. B. J. Talbert, and carried out by one of the oldest and most famous firms in England, Messrs. Gillow. Moreover, it was specially designed as an example of treatment in a given style, that of the later English period. As will be perceived at a glance, it is intended for a dining-room: but it includes novel elements which demand special description. The outer framing is of ebonized wood—that is to say, wood stained to imitate ebony, much used of late, and with excellent effect; the sideboard, or dressoir, is of light-coloured oak; the arras, or hangings, are of figured silk, and the looking-glass over the sideboard consists of a fine plate of glass with chamfered edges in the Venetian style, set in a richly carved frame of pear-tree relieved with ebony, the hangings and the glass harmonizing the black frame and the oak sideboard effectively. The sideboard is boldly decorated with carvings in boxwood; the sconces at the sides and the metal fittings of the sideboard are in hammered brass. The panels of the framework, as shown, are to receive armorial bearings and portraits, and the chairs are covered with embossed and gilt morocco.



ENGLISH MEDIÆVAL CHIMNEY, Etc.

IT is pleasing to see the growing improvement which, thanks principally to the exertions of true artists and the judgment and enterprise of such firms as Messrs. Cox and Sons, is evident both in our public and private buildings; the littleness of dilettanteism is rapidly disappearing, and the educated eye now sees that a Gothic cabinet in a modern room is just as much out of place as would be a Renaissance cabinet in a Mediæval church. The engraving here given represents part of the end of a room with chimneypiece and furniture *en suite*, exhibited by Messrs. Cox and Sons at Philadelphia, and which attracted much admiration. The chimneypiece covers the larger part of the end wall, and the bold decorated coving is to be continued round the room. The lower portion of this monumental chimneypiece is of stone and marble inlaid with hand-painted tiles, and the upper part of oak. The cabinet, chair, in short the whole of the furniture, rug, &c., are in perfect keeping, and exhibit the artistic knowledge and skill as well as the admirable workmanship which characterize the productions of the firm.



ENGLISH TILED FIREPLACE.

COMFORT is said to be unknown out of England, and certainly in some of the arts which promote comfort, such as the manufacture of metal bedsteads, carpets, and stove grates, our countrymen are eminent. The application of keramic work to decoration has of late years become a distinguishing feature of this country; we have given more than one example into which such work enters largely, and we think we cannot conclude this section better than by giving an illustration of Messrs. Minton, Hollins & Co.'s contribution, in this class, to the Philadelphia Exhibition. It would be absurd to dwell upon the productions of this eminent firm; they are to be seen in churches, palaces, and mansions all over the kingdom and in many places beyond it, and every Exhibition brings forth more beautiful examples.





ENGLISH AND SCOTCH CARPETS.

THE upper figure represents a quarter of a Carpet manufactured by the highly-reputed firm of Lapworth & Co., of London, for Buckingham Palace. The rose, thistle, and shamrock border is superbly designed, and the ivy ground beautifully simple.

The other example is the work of Messrs. Templeton & Co., of Glasgow. It is remarkably rich and elegant, full of beautifully-designed scrolls, bouquets, borders, and bas-relief ornaments in panels—a capital example of this class of carpet designing.

Both these beautiful carpets were exhibited in 1851.



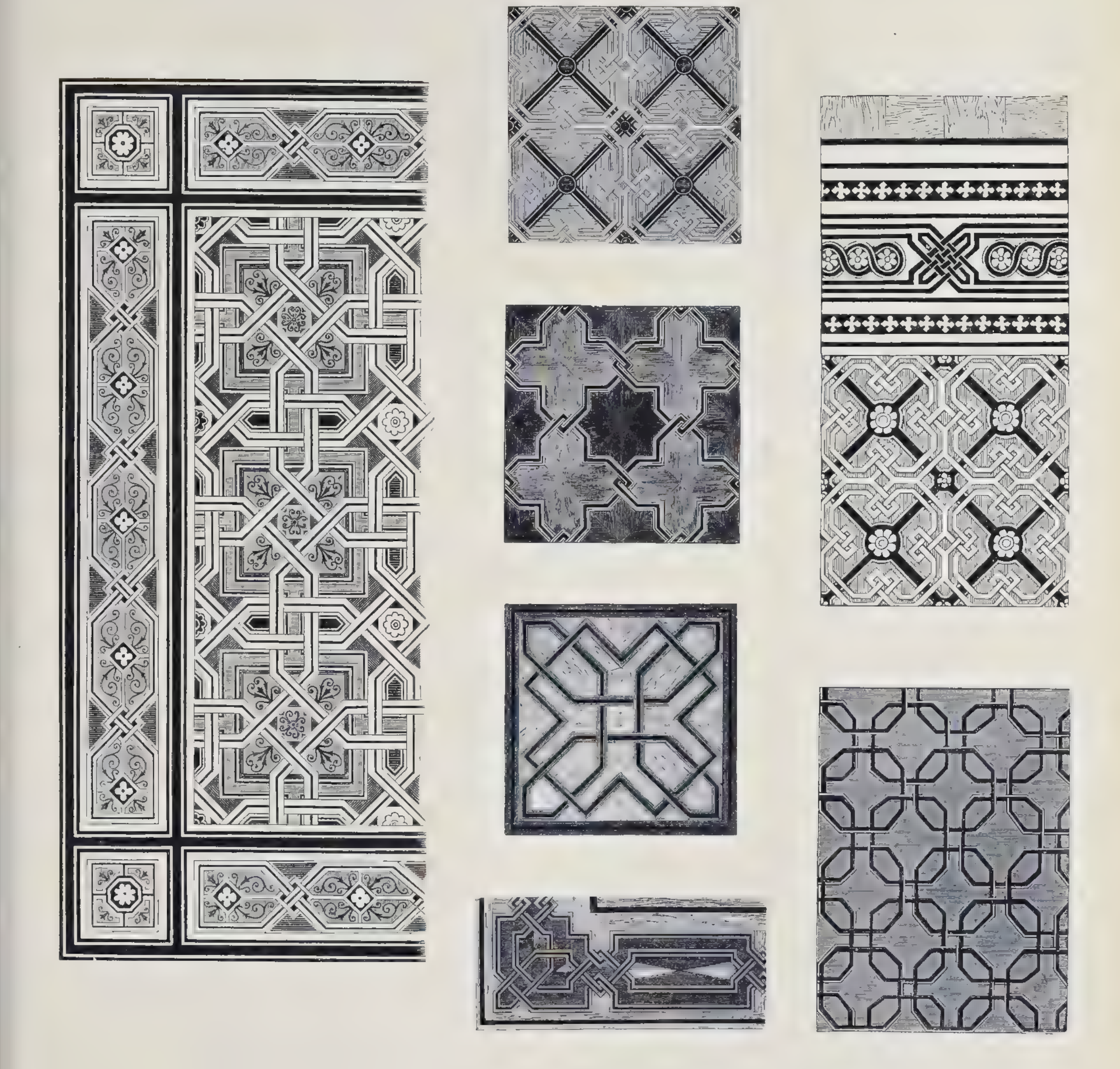




ENGLISH CARPETS.

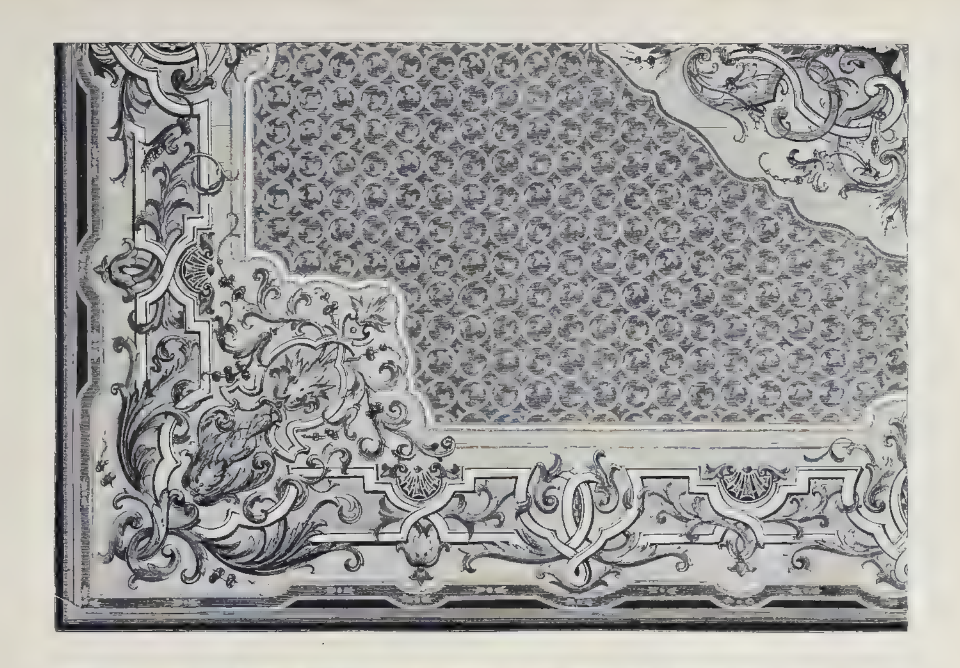
A RICH Hearthrug, in the pictorial style, exhibited by Messrs. Jackson and Graham at the Dublin Exhibition in 1853. The centre is occupied by the magnificent *Victoria Regia* lily, and this and the superb wreath of flowers which forms a border are admirably designed.

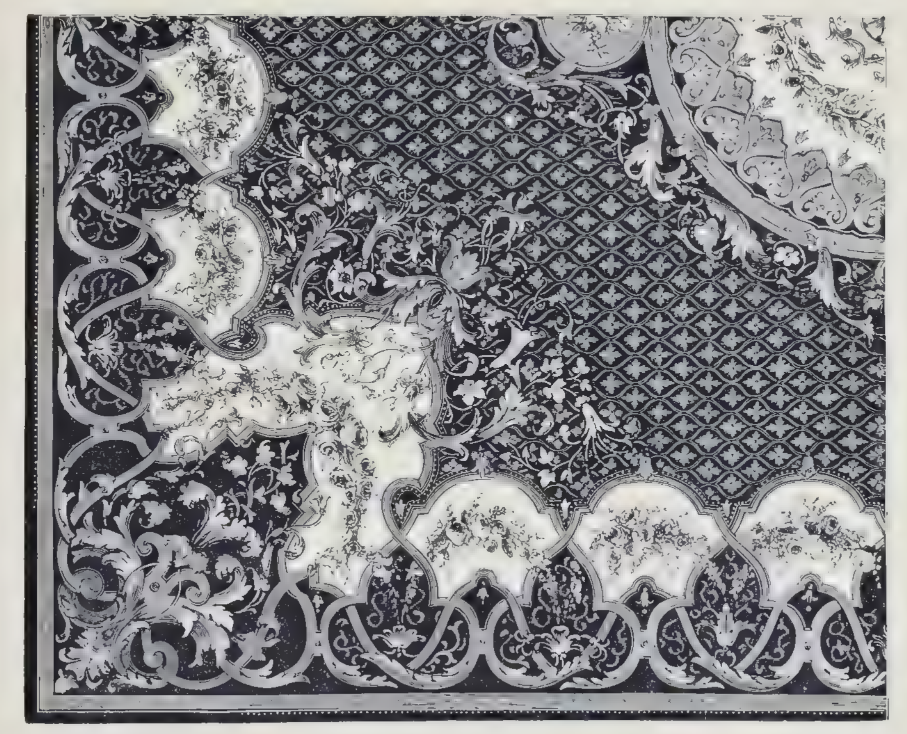
Below, to the left hand, is a portion of a Carpet by Messrs. J. Bright & Co., of Craig, near Macclesfield; the design is remarkable for its boldness. The third figure represents a work of Messrs. Turberville, Smith & Co., a charming adaptation of the fern to decorative work. The latter two were shown in 1851.



PARQUETRY.

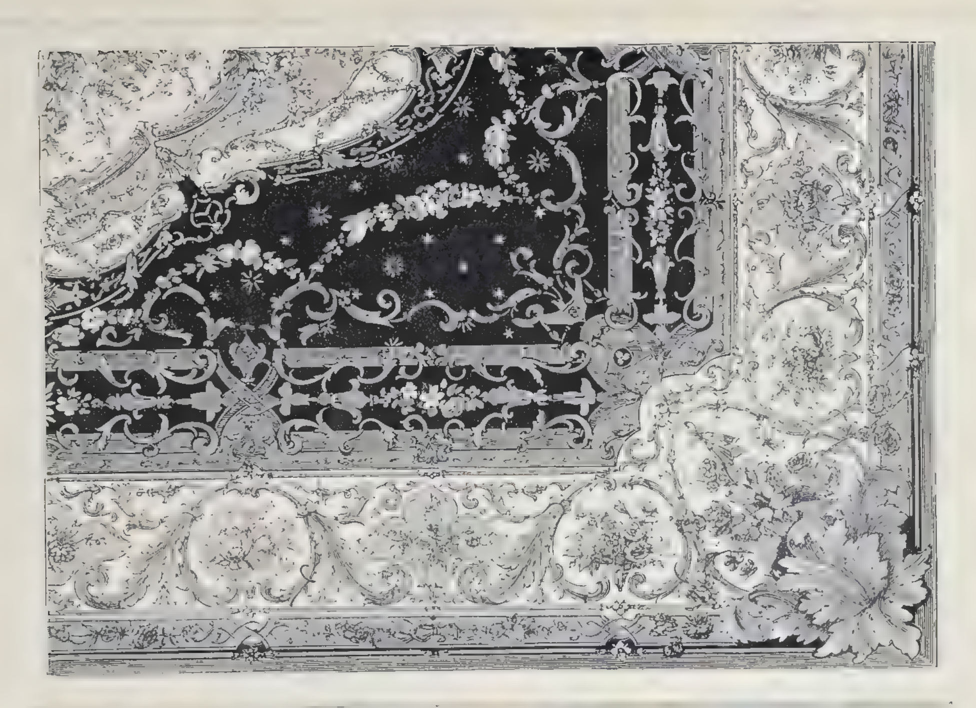
A COLLECTION of admirable examples of wood floor-work—parqueterie—in which, with one very slight exception, the ornamentation is perfectly flat, as all ornamentation should be which is to be trodden on, walked over, &c. Some of the geometric patterns here shown are simple and some complicated, but they are all good and deserving of study. The fine example which occupies the side towards the left hand is by Messrs. Wirth, of Stuttgard; the bright specimen above on the opposite side by MM. Dekeyn frères, of Brussels; that below the preceding by Herr Leistler, of Vienna—a simple-looking pattern enough in black and white, although, admirably adapted and executed as it was in several kinds of wood, from white lime to rosewood, the effect was very rich. The specimens which occupy the middle of the sheet are excellent examples of the work of Mr. Armstrong, of London, who was, we believe, one of the first to employ machinery, and thus, by rendering parquetage moderate in price, brought it into use in this country.

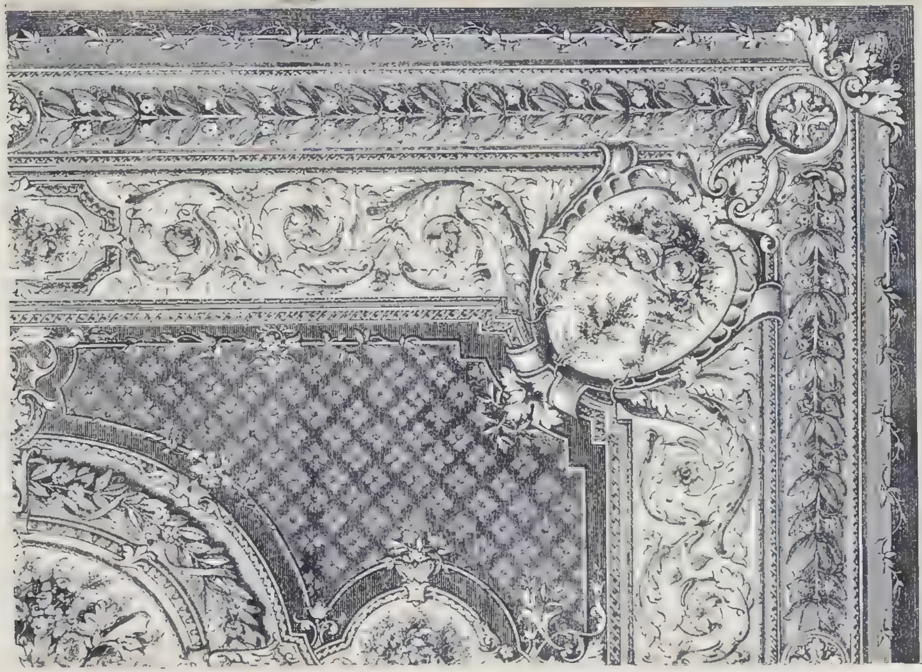




ENGLISH CARPETS.

THE example above is by Messrs. Watson, Bell & Co., and that below by Messrs. A. Lapworth & Co., both of London: there is a certain similarity of treatment between them—in each case the ground is peculiarly simple and admirably adapted for the covering of a floor, while the centre and border are in a high degree elaborate, and, in the latter case, extremely fanciful; the designs in both cases show much skill. These Carpets were shown at the Great Exhibition of 1851, and they belong to a style which in this country has given way before the influences of Indian Art on the one hand, and Mediæval taste on the other.





ENGLISH CARPETS.

TWO magnificent Carpets by well-known firms, who have produced innumerable beautiful works of Art in this and other branches. The upper was exhibited at our first Great Exhibition by Messrs. Watson, Bell & Co., of London, and deserves great praise for the brilliancy of the general design, the contrast between the light, graceful border and the dark ground, and again the charming, airy centre: the whole of the flowers and other details are beautifully drawn, especially the scrolls of the chief border, and the beautifully bold corners of the same, with the splendid acanthus leaves in the angles. There is one objection, however, to all such beautiful carpets, namely, the difficulty of finding furniture or even ladies' dresses that will bear comparison with them.

The other example is a patent Axminster by Messrs. Jackson and Graham, exhibited in 1862: here we have a more severe treatment with equally admirable drawing and a sumptuous effect. The two borders, three indeed, are most artistically designed to set each other off to the best advantage; nothing could be finer than the drawing of the wreath of flowers in the great oval in the corner, and of the grand scrolls of the inner border.

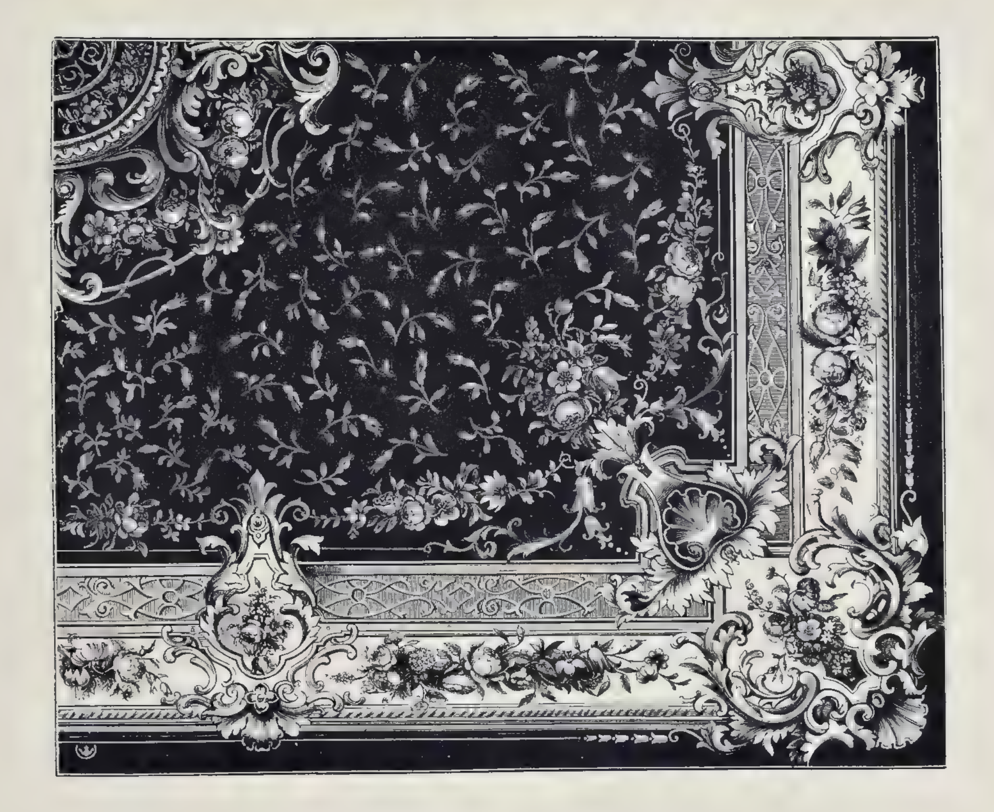




ENGLISH CARPETS.

TWO of several beautiful Carpets contributed to the International Exhibition of 1862 by Messrs. Watson, Bontor & Co., of London. It would not be easy to find more successful examples of design in this class than those here presented: the exotic plants which have supplied the elements of the design are beautifully drawn, and, moreover, exhibit that which is much more rare, admirable composition; the artist has shown his knowledge and versatility by producing three designs with the same elements, the simple border in the smaller example, the beautifully elaborate one in the larger, and the more dispersed arrangement which decorates the ground of the larger carpet. The ground of the small carpet is much to our taste, and contrasts charmingly with the border.

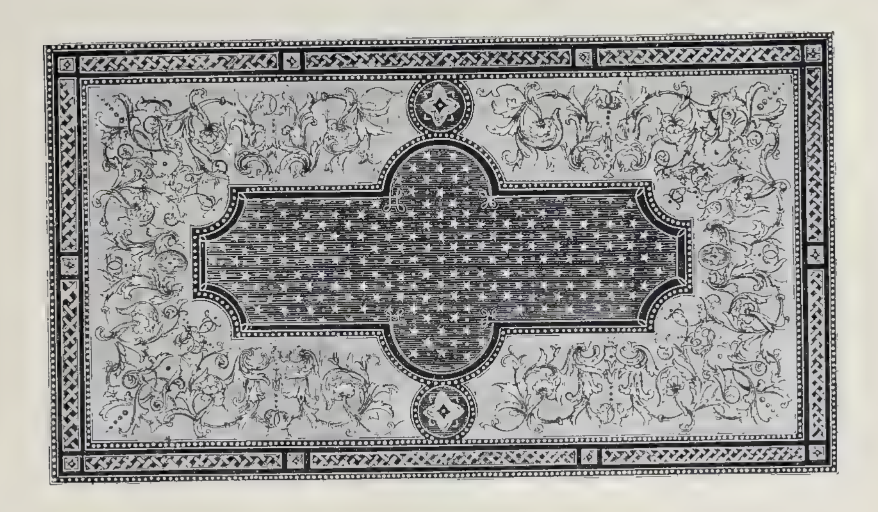


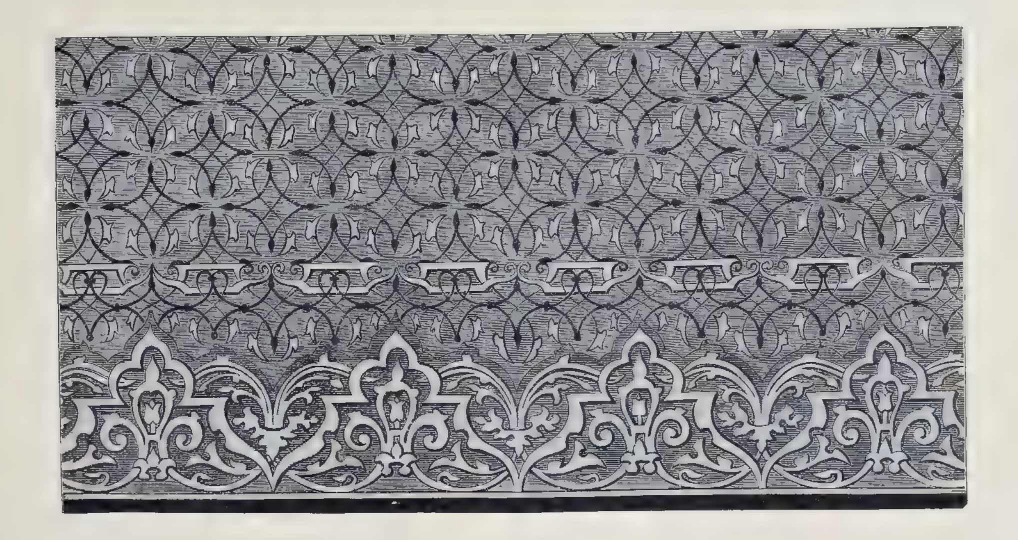


ENGLISH RUG AND CARPET.

THE Rug which occupies the upper place here is from a very pretty floral design by Miss Gann, now directress of the Female School of Art; it was exhibited by Messrs. A. Lapworth & Co., of London, in 1851.

The magnificent Carpet represented below is a fine example of the florid style greatly in vogue at the period above-mentioned. As examples of design and drawing, the centre and borders are remarkable for boldness and beauty; the wreaths of flowers, the shells and scroll-work, are designed with a masterly hand. The style is now utterly condemned by the taste of the present day, the opinion being all but universal that nothing is suitable for the ornamentation of a flat surface—like a floor, which is to be walked upon—but that which is in itself flat, and that carpets should not vie in brilliancy with works of art, ladies' dresses, or even furniture. It is by Messrs. White & Co., of London.

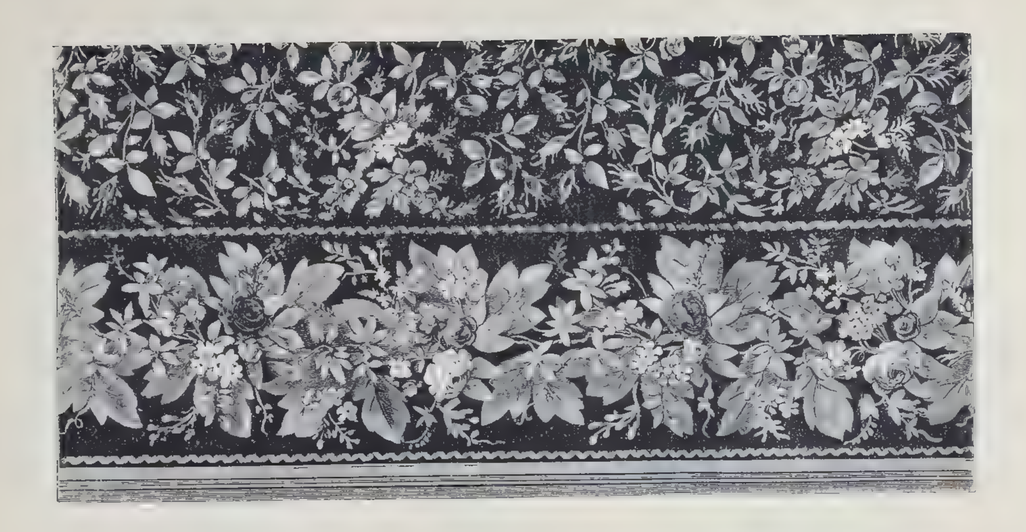


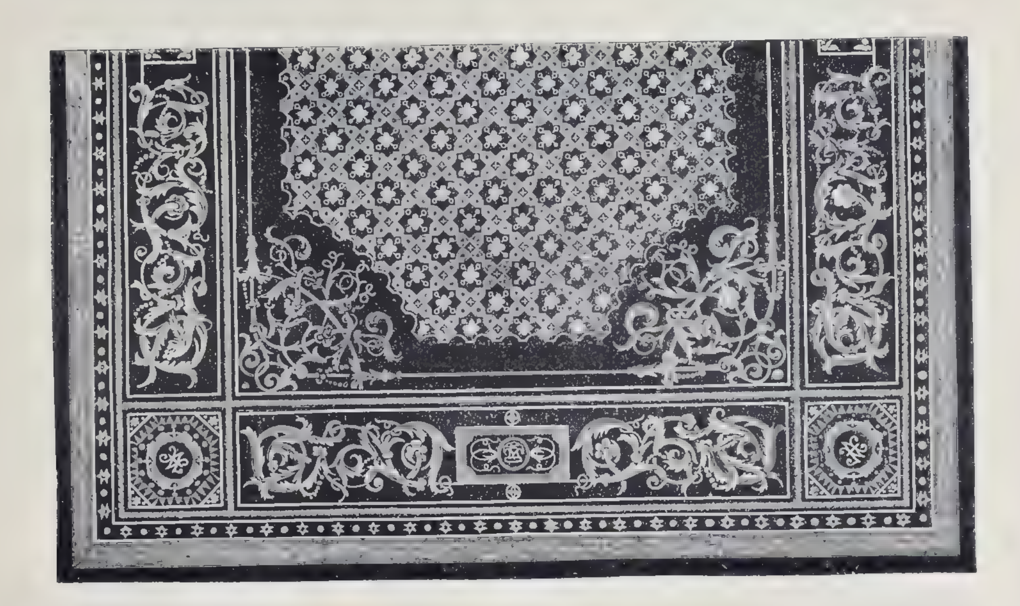


ENGLISH CARPETS.

THE first of these examples is a "Patent Axminster" or Chenille Carpet, designed by the late Sir Matthew Digby Wyatt, who contributed largely to the improvement of ornamental design in this country in many, if not all, branches of Art-manufacture—jewellery, metal-work, textile, and bookbinding, amongst others. The Carpet is the production of Messrs. Templeton, of Glasgow, for Messrs. Sewell, Hibbard, and Bacon, of London.

Our second engraving represents a portion of a Carpet, of a kind intended for general use; but here also we have evidence of truly artistic taste in the designer, Mr. Wm. Parris, who has, we believe, supplied the manufacturers, Messrs. Gregory, Thompsons & Co., of Kilmarnock and London, with this and other pure and simple designs. These carpets were exhibited in 1862.

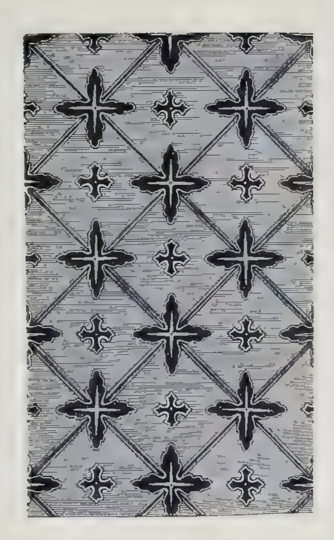


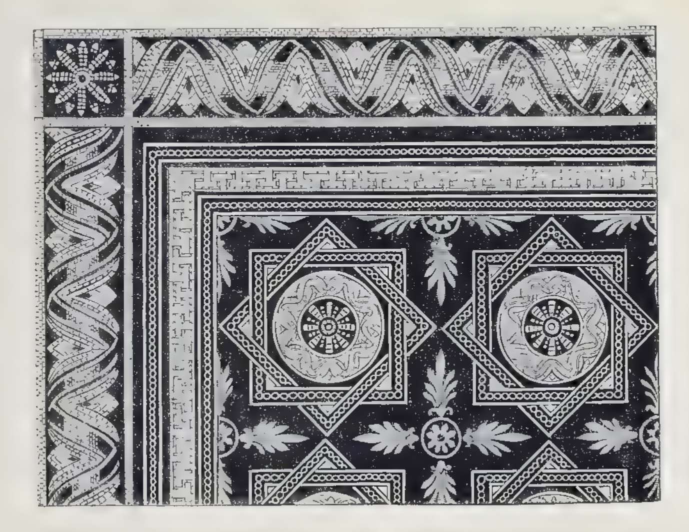


ENGLISH CARPETS.

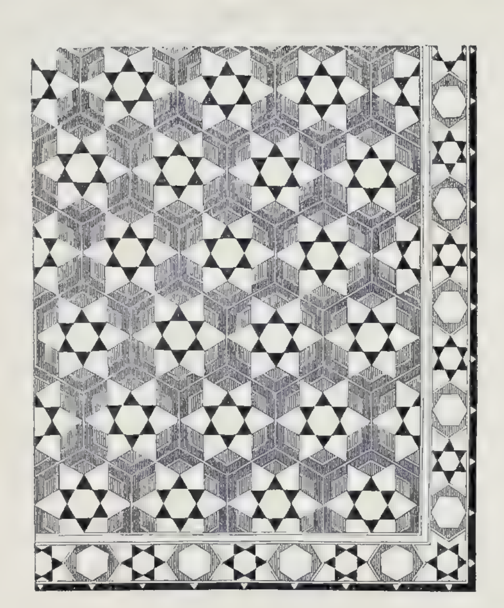
THE upper example is a pretty floral Carpet by Messrs. Gregory, Thomson & Co., of Kilmarnock of whose productions we have given other specimens; the design is skilful, the centre and border just sufficiently different to give effect with harmony.

The second engraving represents a portion of a Carpet manufactured by Messrs. Templeton, of Glasgow, for Mr. C. Gregory, of London; it is what is called a "patent Axminster," or chenille, carpet. The design was by the late Sir Matthew Digby Wyatt, and is of a high order of ornamentation adapted with admirable taste. Our engraving, though not on a large scale, shows fairly the work of the accomplished artist, but, unfortunately, the rendering of the rich colours in all their delightful harmony is beyond our powers; in fact, the glowing colours which the skilful dyer confers on wool set the most accomplished printer of colours at defiance.





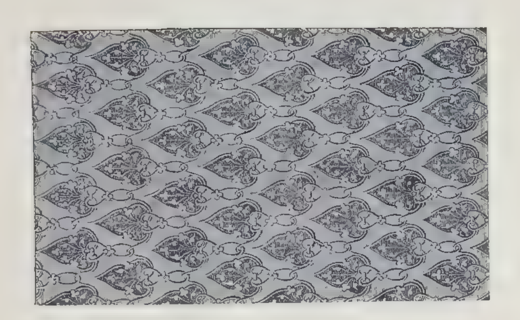


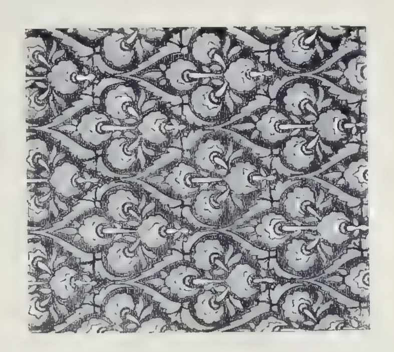


KAMPTULICON AND FLOOR-CLOTH.

THE floor-covering fabric formed of indiarubber and cork reduced to powder, and called by the fanciful Greek compound kamptulicon, with its relatives linoleum, cork carpet, corticene, &c., have become articles of large consumption, and, considering that they are comparatively warm, elastic, and silent under foot, they are much better than floor-cloth. But they have another claim to our attention: the general colour of these fabrics is neutral and pleasing to the eye, and the best kinds take colour very readily. Fortunately also these fabrics came into notice just when real attention was being paid to decorative Art in this country, and the result of all these circumstances has been that the ornamentation employed by the manufacturers has been generally judicious and elegant. We have already given some examples and we here append two others—an imitation of mosaic pavement, and an extremely simple diaper pattern; the examples were exhibited by Messrs. Trestrail & Co.

The other two engravings represent floor-cloths manufactured by Mr. R. Y. Barnes, of London, who has called to his aid an eminent designer for manufactures, M. Clerget, of Paris, who has succeeded in producing two excellent designs of a different class, both admirably adapted to the intended purpose.









ENGLISH CARPETS, Etc.

THE two larger engravings here given are of Carpets by Messrs. Morton, of Kidderminster. The designs, which are by Mr. J. K. Harvey, who is attached to the establishment, are very good: the ground is well covered, without confusion; the colours are neither too many nor too glaring; and lastly, which is a point of considerable importance in a carpet or any other floor covering, the designs are seen equally well in any direction.

We find space here for two small examples of a different character, but good designs are welcome anywhere and at any time. That towards the left hand is an additional example to that given elsewhere of the productions of the Embossed and Gilded Leather Cloth Company of England, France, &c.; the other is a charming wall-paper pattern by Messrs. Scott, Cuthbertson & Co., of Chelsea.





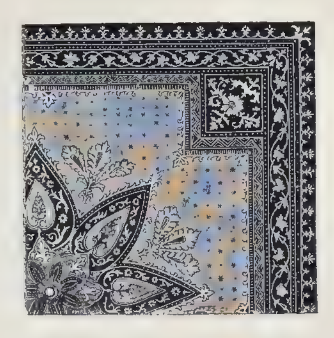




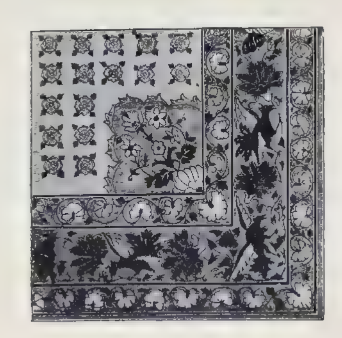
SCOTCH AND ENGLISH CARPETS.

THE pretty, tasteful example above with the laurel wreath and ribbon border is a Brussels Carpet, and the charming Byzantine example next to it a Scoto-Axminster, by Messrs. Richard Whytock & Co., of Edinburgh, well-known producers of tapestry and carpets of all kinds.

On the lower line are two specimens of the excellent productions of Messrs. Morton and Sons, of Kidderminster; the designs are by Mr. J. K. Harvey, who has long been the designer for the firm, and has produced some of the most charming patterns in the trade. The two designs here represented are worthy of his pencil. These two latter examples were contributed to the International Exhibition held in Paris in 1867, upon which we now enter.



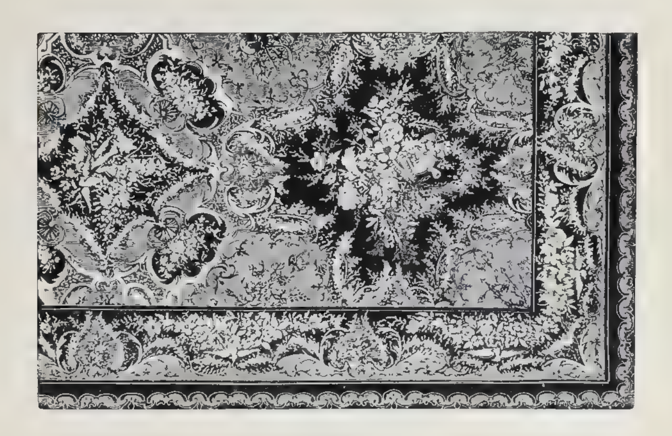


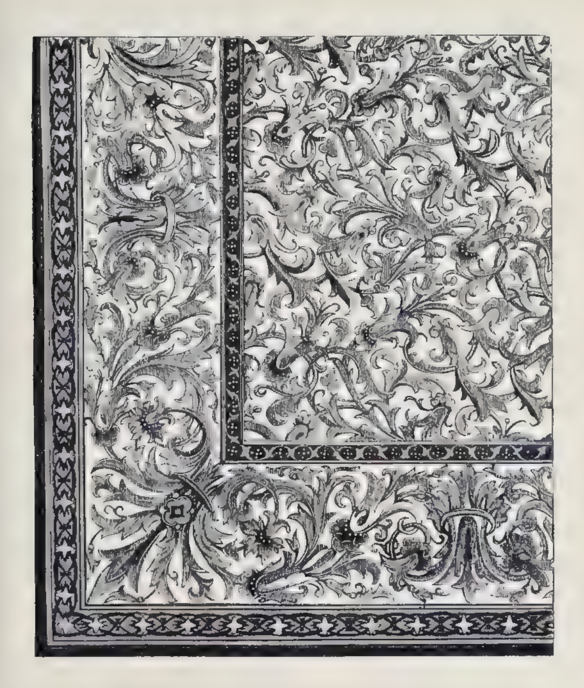




AUSTRIAN PORTIÈRE AND TABLE-COVERS.

THESE four articles are from the manufactory of Herren Philip Haas and Sons, of Vienna, who are highly esteemed producers of all kinds of furniture fabrics in silk, wool, and thread, as well as of carpets and tapestry hangings; and their reputation all over Europe is derived largely from the beauty and fitness of their designs, which are supplied by the first artists in Germany. There is great delicacy and variety in the patterns here represented; and all have the high quality of fitness for the purpose intended; that is to say, they are all treated perfectly flat, without shadows. They are admirable examples of designing for textile fabrics.







ENGLISH AND SCOTCH CARPETS.

ABOVE is a very beautiful example of the work of Messrs. Lyle & Co., of Glasgow; the design is a charming blending of antique types with floral ornamentation, admirably suited to its purpose.

Below are two specimens of the high-class workmanship of Messrs. Woodward, Palmer, and Radford, of Kidderminster; the designs are very remarkable, one for most ingenious elaboration, the other for much novelty and lightness and charming contrast.

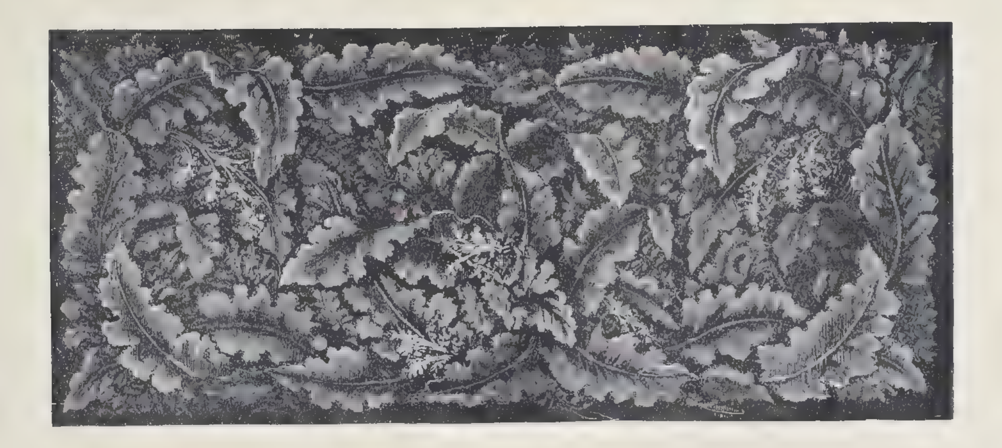
Such productions as these do honour to our manufactures.



ENGLISH CARPET.

A BEAUTIFUL example of English design and English workmanship, exhibited in Paris in 1867 by Mr. Turberville Smith, of London, whose productions had previously attracted much attention. Mr. Smith was amongst the earliest of the carpet manufacturers who, seeing the grave mistake which we had made for a long period of years in attempts to strew our floors with gigantic roses, or, what was still worse, with architectural ornaments, called to his aid the true artist and helped to teach the people, not only of this but of other countries who for a long time revelled in similar glaring monstrosities in one or other form of Art-manufacture, the beauty and the constant delight of refined, suitable, and unpretending design. That before us is by the late Sir Matthew Digby Wyatt, whose learned and skilful pencil has supplied us with several charming works for the illustration of our pages; it is a fine chapter in Ornamental Art for students.

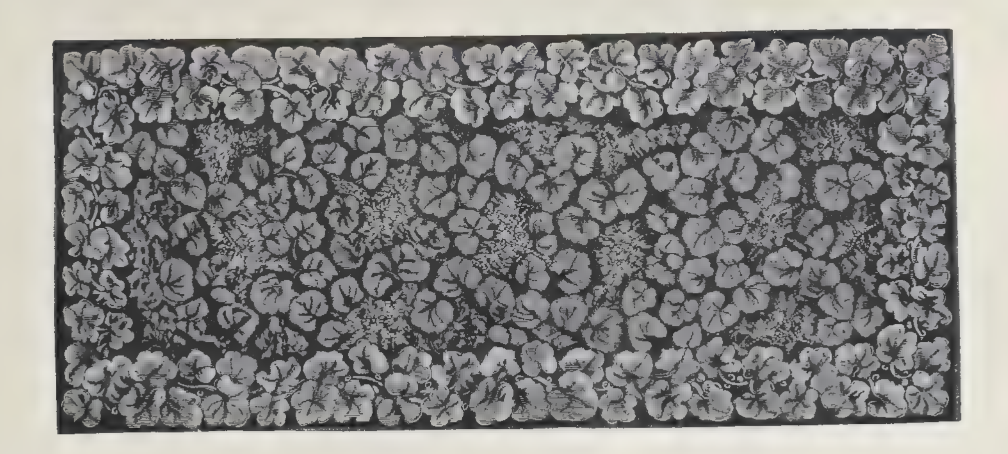


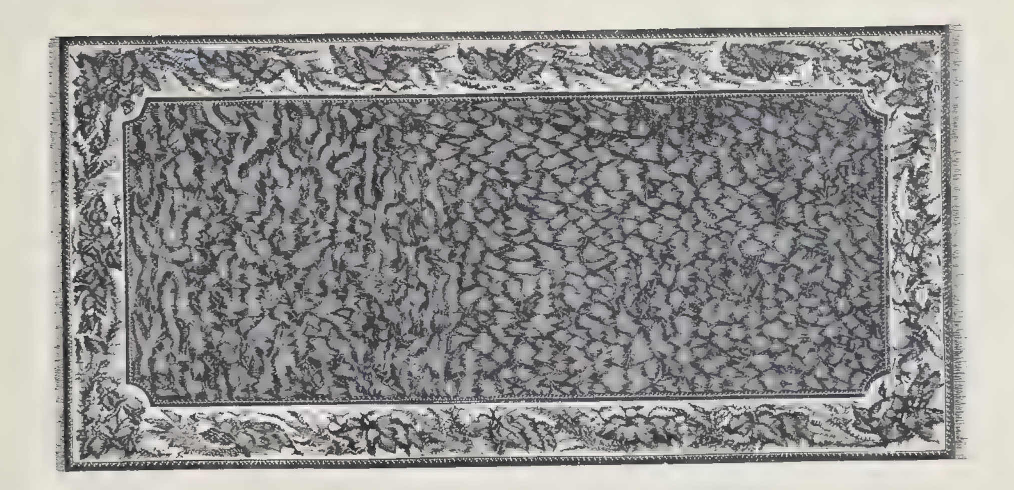


ENGLISH RUGS.

HAVING completed our illustrations of this section down to the end of the period terminating with the Paris Exhibition of 1867, we have to add a certain number of examples from various sources dating from that time to the present.

We have more than once referred to the immense improvement which has taken place in the patterns—many did not deserve the name of designs—and we may add the colours of our carpets, and the same observation applies with equal force to our rugs, which in our younger days were, with rare exceptions, without one good characteristic except that of excellent materials and fabrication. Here we have two examples from the well-known firm of Tomkinson and Adam, of Kidderminster. Both the designs are admirably adapted for the purpose to which they are applied, the effect of the hart's tongue fern being peculiarly graceful. The designs, we understand, are by artists attached to the firm.





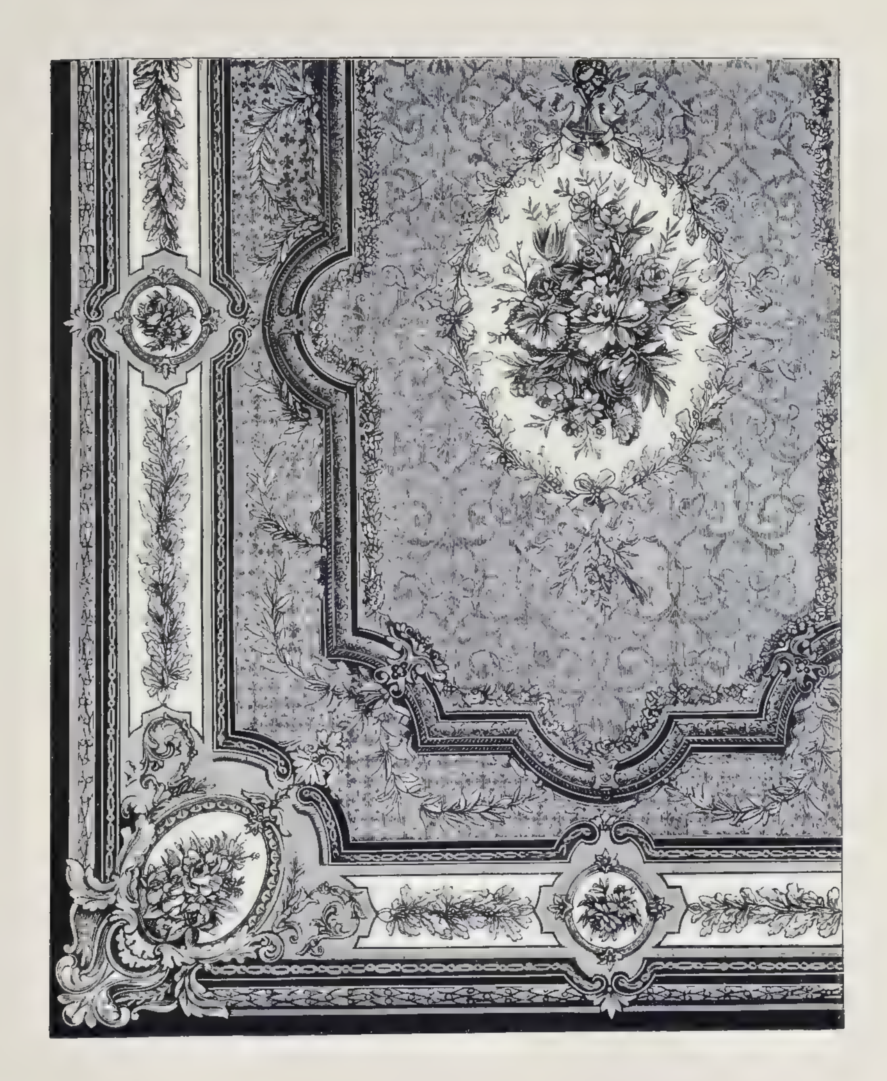
ENGLISH RUGS.

TWO excellent examples by Messrs. H. R. Willis & Co., of Kidderminster and Coventry, who have achieved a high reputation for their rugs as well as for the beautiful carpets which still bear the name of Wilton, the town where they were first made. The leaf pattern of the upper illustration is extremely happy, and the introduction of white very judicious and effective. There are many of our wild plants, weeds of the earth and of the water, which have small leaves of this class peculiarly adapted for the purposes of the designer, and varying almost in every shade, from yellow-green to bronze, supplying at once gradations of colour as well as beauties of form.



ENGLISH AXMINSTER CARPET.

ONE of the most beautiful of the lamented Owen Jones's designs executed in the finest carpet fabric produced in this or any other country. The design was specially prepared by the artist for Messrs. Jackson and Graham, who produced and exhibited the Carpet at the International Exhibition at South Kensington in 1871. Mr. Owen Jones has here adopted the Persian style, but he has applied it in a manner all his own: the drawing of the ornamentation is very remarkable. We believe that this carpet was intended to be an example of the finest "patent Axminster" ever woven, and its delicacy may be partially described from the fact that it contains two hundred and fifty-six "points"—that is to say, separate tufts of wool—to every square inch, thus affording extraordinary means of showing the beautiful variations in the design. As to colouring, Owen Jones knew how to blend and harmonize his colours as well, perhaps, as any Persian or other Oriental in the world.

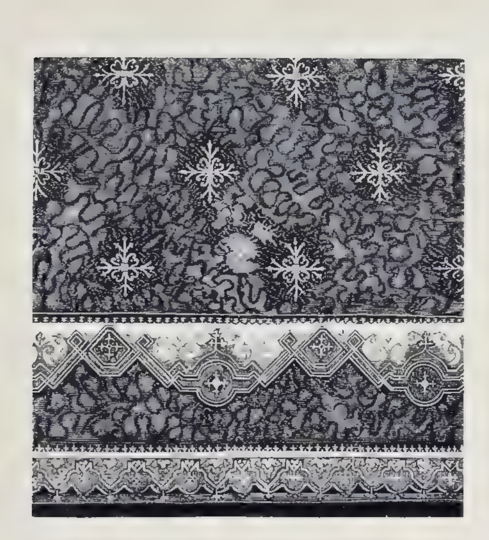


SCOTCH AXMINSTER CARPET.

AN excellent example of the admirable manufactures of Messrs. James Templeton & Co., of Glasgow, of the kind known as "patent Axminster" of the best class. These carpets, it should be mentioned, are woven without seam to fit any given room, no matter of what size, and the firm has acquired well-deserved reputation. In the engraving before us the design is sufficiently well shown, but the colours require a few words of explanation. The ground is drab, with white centre, border, and corners, the flowers are in their natural colours, and the other ornamental work in subdued golden tints, all blended with great skill.



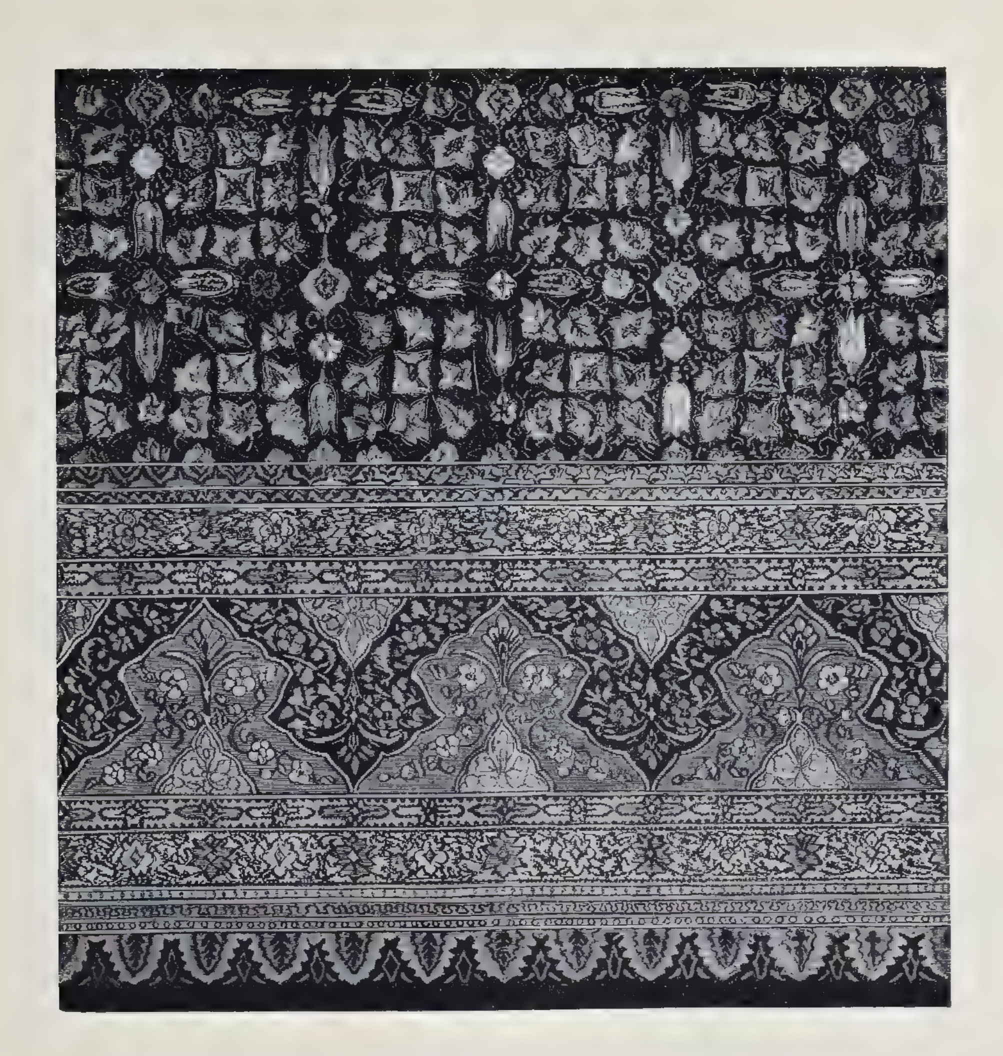






WILTON CARPETS.

FOUR specimens of the beautiful Wilton Carpets produced by Messrs. H. R. Willis & Co., of Kidderminster, who have achieved a high name for these charming productions as well as for their rugs, of which they produce almost every variety. The patterns before us are worked in brilliant and harmonious colours in an extremely delicate fabric, that is to say, formed of fine wools closely laid together, and the effect is admirable. Three of the four designs have this in common, that moss has furnished the ground pattern; then again, the floral designs in three—not the same three—are produced by the artistic arrangement of simple well-known flowers and leaves, all treated as flat ornament in the true spirit of design according to the best authorities.



PATENT AXMINSTER CARPET.

THE Exhibition of 1871 at South Kensington was peculiarly rich in English Carpets, and, although we have already given several examples, we must add two or three more. That which is here engraved is a specimen of the fine "patent Axminster," produced by Messrs. John Brinton & Co., of Kidderminster. We wish we could give the colours and the texture which form the grand features of a carpet; we are limited to black and white, and can only show the form of the pattern, which is well suited to its purpose, and is conceived in perfect harmony with the practice of the Orientals, who in these matters are our acknowledged masters.

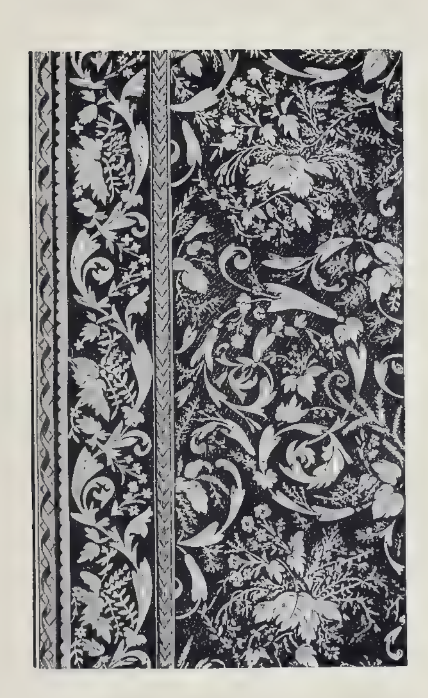


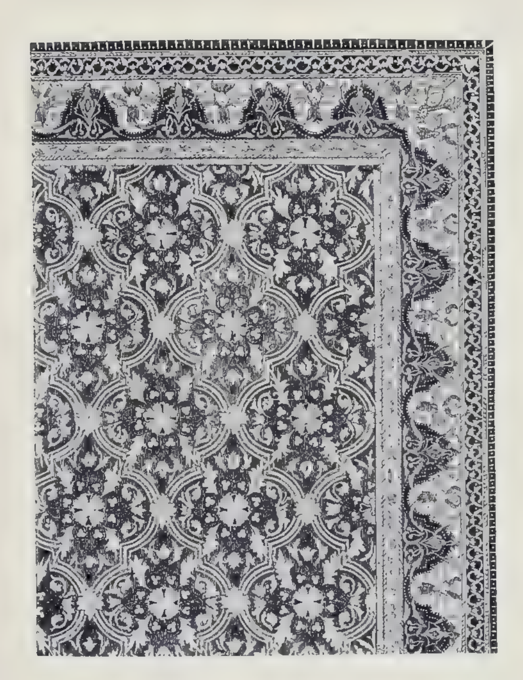


PATENT AXMINSTER CARPETS.

MESSRS. JAMES TEMPLETON & CO., of Glasgow, have obtained high reputation and rewards for their beautiful Carpets, and they have shown as much attention to the artistic as to the constructive portion of their manufacture. The first of these examples here illustrated is of the ornate style, which has had a long run, but is now rather gone by. We prefer a different kind, but we cannot but admire the beauty of the work in this and other borders in the same style; the pattern of the ground is admirable. The second example is in a totally different style, a flat diaper design, one of Owen Jones's later works, and an admirable specimen of that consummate artist's work. The groundwork is charmingly drawn, but the rich fancy of the designer is shown in the complicated border, with its fine strongly contrasted parts made up of the simplest elements. This Carpet was a superb piece of colouring.







CARPETS.

THE Vienna Exhibition of 1873 supplies us with some admirable examples of carpet work. The first, that on the upper line, is a Stair Carpet by Messrs. James Humphries and Sons, of Kidderminster; the pattern is an adaptation of the Indian style, and is not only most effective, but admirably adapted to its purpose—peculiarly light, graceful, and effective.

The third is an admirable example of Messrs. John Brinton & Co.'s famous manufacture; the flat design is very elegant, and must have been the work of a learned and skilful ornamentalist: the effect is charming.

We take advantage of the remaining space to give an engraving of a Carpet of a few years' earlier date, namely, 1867. The design of this is admirable, the border especially; we regret that neither the name of the artist nor of the manufacturer is known to us.







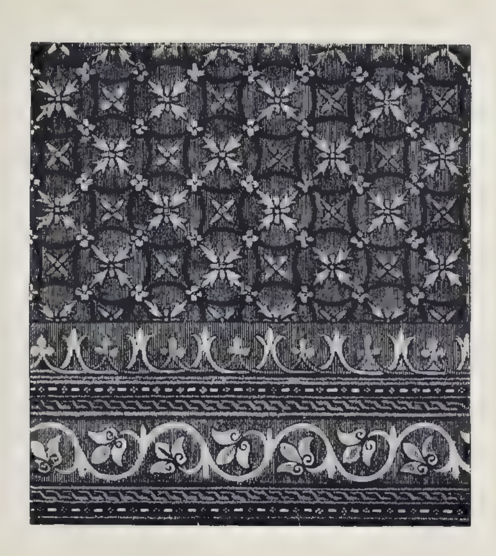


ENGLISH CARPETS.

THE two examples occupying the upper line are by Messrs. James Humphries and Sons, of Kidderminster, other specimens of whose excellent productions will be found amongst our illustrations: the first is very remarkable as to pattern, which is in the Egyptian style, adapted with great ability and good taste; the Carpet is intended for a dining-room. Its companion presents a perfect contrast, the design being essentially modern and floral, admirably adapted for a boudoir or small drawing-room.

The specimens below are by another famous manufacturing firm of the same town, Messrs. Tomkinson and Adam; the first is specially remarkable for a beautiful border, the second is a specimen of the grand Axminster made specially without seam for royal or noble rooms. Both are deeply indebted to the antique.

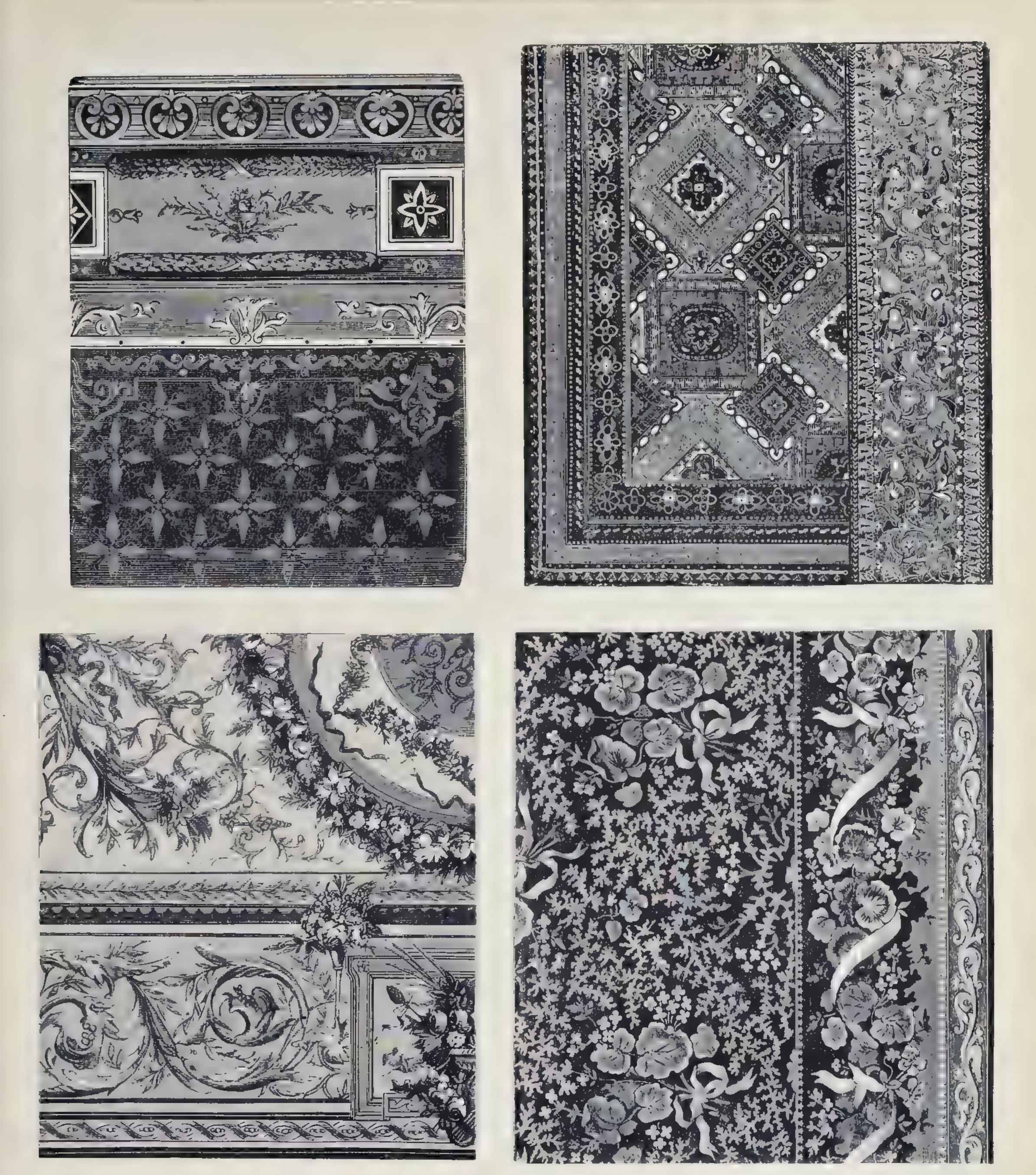






ENGLISH CARPETS.

THE most important example which we give on this page is from another of the splendid Axminster Carpets of Messrs. John Brunton & Co., of Kidderminster, to whom we are already much indebted; the pattern is full of novelty and beauty. The two smaller specimens are also by the same firm, but they are of a different kind, namely, Wilton —of which manufacture, as of "Brussels," Kidderminster has now almost a monopoly, while not a yard of "Kidderminster" is made there, as we believe. Here we have designs suitable to the delicate texture of Wilton, and for rooms of moderate dimensions; the ground patterns are carefully studied, and the classic types are admirably adapted in the elegant borders, especially in that of the Carpet towards the right hand, which is highly effective.



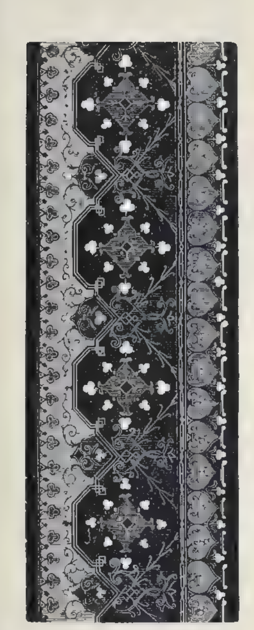
ENGLISH CARPETS.

THE two engravings which occupy the side of the page towards the left hand represent portions of the famous "patent Axminster" Carpets of Messrs. Templeton & Co., of Glasgow: like all the productions of the firm, they are full of artistic grace, whether the treatment be classic, floral, or conventional; the scrolls both in the border and ground of the lower example are charmingly drawn.

On the other side, above, is a good specimen of geometric design, with a pretty piece of bordering, by Messrs. Tomlinson and Adam, of Kidderminster. This Carpet is peculiar in the arrangement of its parts, made to meet special circumstances, or only as a compound specimen.

We devote the remaining space to an example by Messrs. Goode, Gainsforth & Co., of London, for which we wanted room. It was exhibited in 1862, and is a very pleasing specimen of floral design.







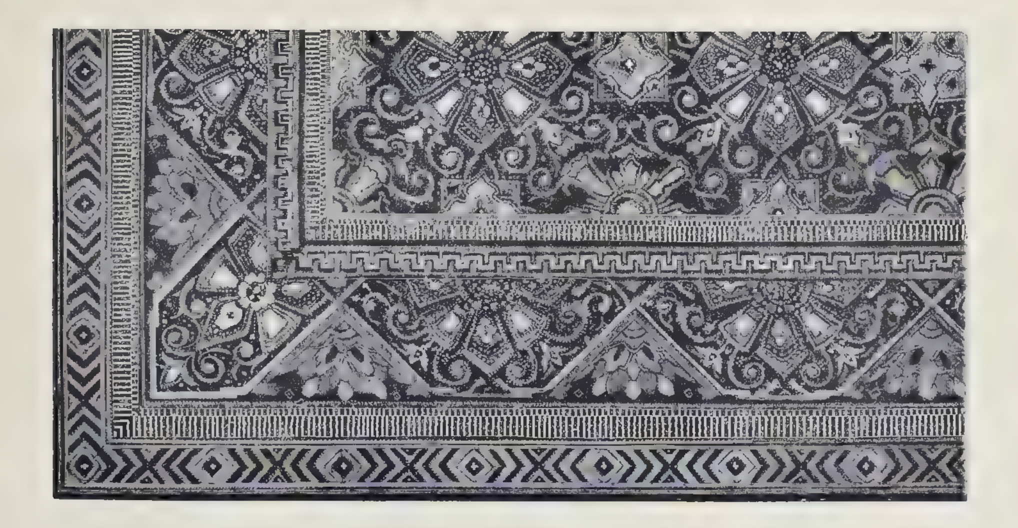


ENGLISH CARPET WORK.

THE magnificent Carpet which occupies the middle of this sheet, and the specimens of borders by its sides, are the productions of Messrs. Gower, Woodward & Co., of Kidderminster. The carpet, or the style of design, we know not which, is called "Hohenzollern:" this example is of large size, and is woven without seam. These Hohenzollerns seem all to have central medallions and cornered inner borders, as here shown. All the designing betrays the artistic hand, and especially the borders; that to the right is an excellent bold adaptation of the antique, and that on the left most delicate and fanciful.

Above we find space for a specimen of a richly designed floral scroll Border of earlier date.

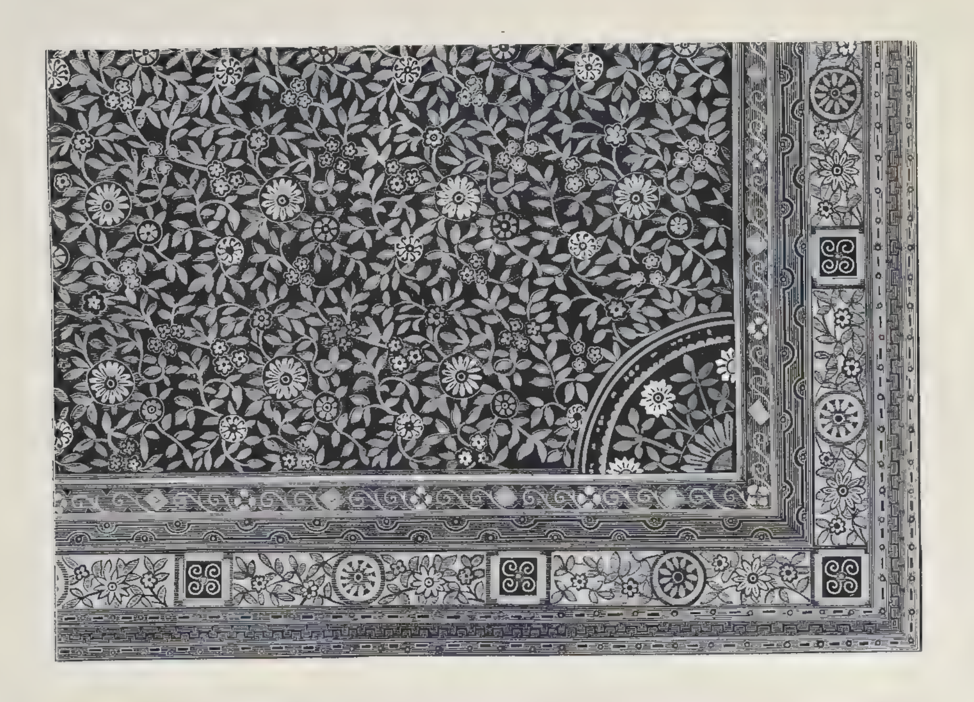




ENGLISH CARPETS.

THE example on the upper line is from another of Messrs. John Brinton & Co.'s beautiful fabrics, which we cannot praise more highly than we have already: the design of the ground in this case is an admirable piece of conventional floral work, within varied and effective borders.

The larger specimen is also by the same firm, of an earlier date by a year or two; it is an "Axminster," specially designed in warm colours for an English dining-room.

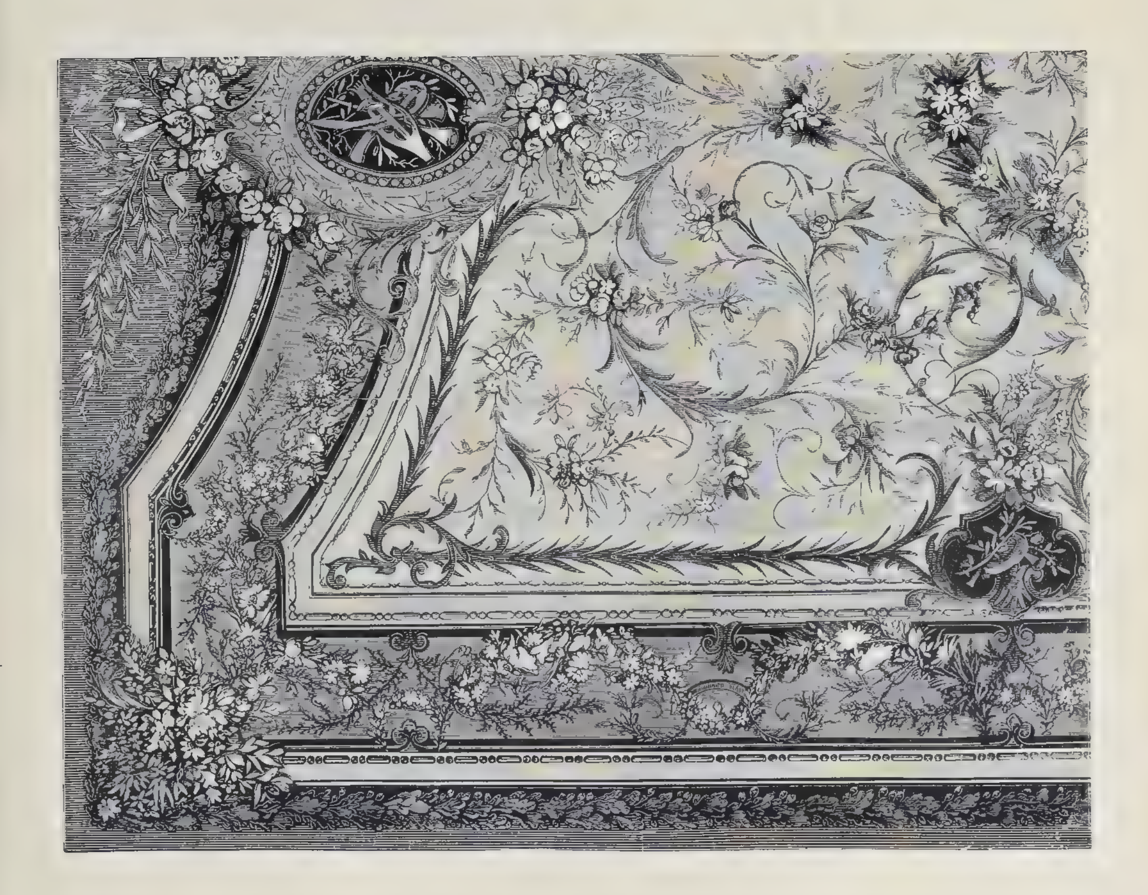




ENGLISH CARPETS.

THE few sheets that remain of this section we shall devote to examples which were shown at Philadelphia on the occasion of the Grand Centennial Exhibition of 1876.

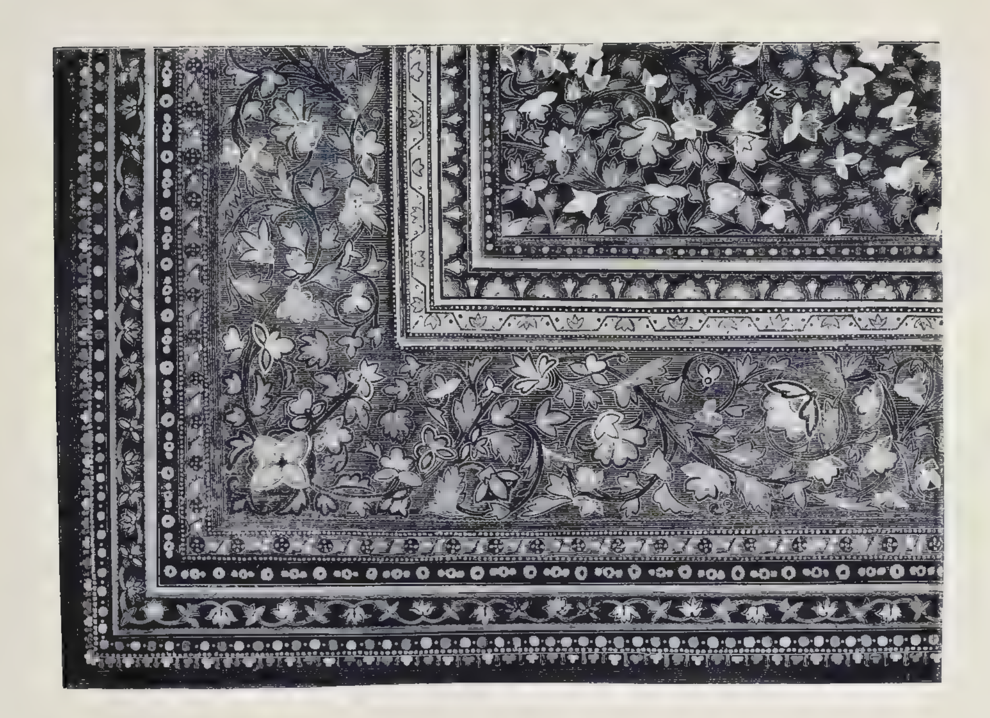
The two with which we commence are "Axminster" Carpets, by Messrs. Tomlinson and Adam, of Kidderminster, who have supplied us with several previous examples, but none superior to these in design. The leaf and flower ground of the first, and the broad central border of the second, are admirably designed, and they are effectively set off by the great chasteness of the other portions of the design. It is pleasant to note the effect of past lessons, and to be able to regard English carpets as, if not superior to those of all the rest of the world, at any rate equal in design as well as in texture to any others made in Europe.



SCOTCH CARPET.

ONE more example from the famous looms of Messrs. James and J. S. Templeton, of Glasgow. The pattern, as usual with this firm, is bold and full of vigour; the scrolls of the ground are on a scale which requires real artistic treatment—an ugly curve or a weak stalk would tell horribly in such a bold pattern as this before us; but here the eye follows with pleasure the lines of the pencil, which are varied and full of grace; the conventional dark stem bordering which surrounds the ground is a capital feature. The floral border is also very charmingly drawn.





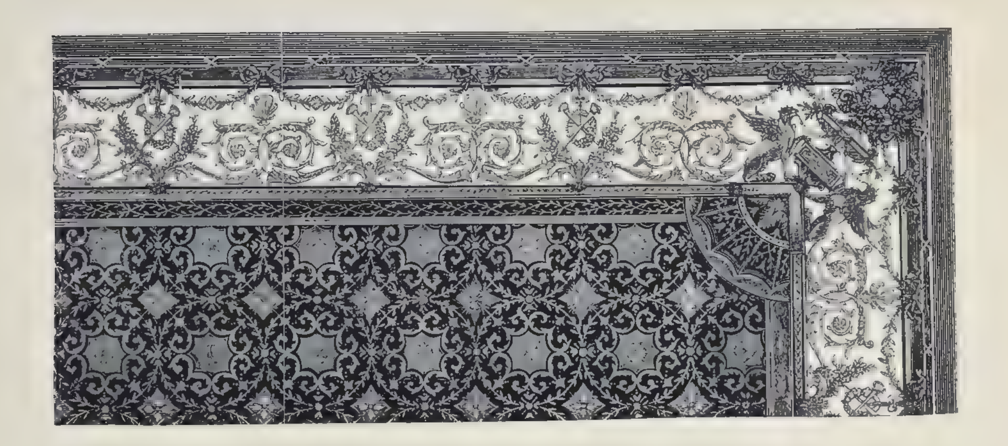
ENGLISH CARPETS.

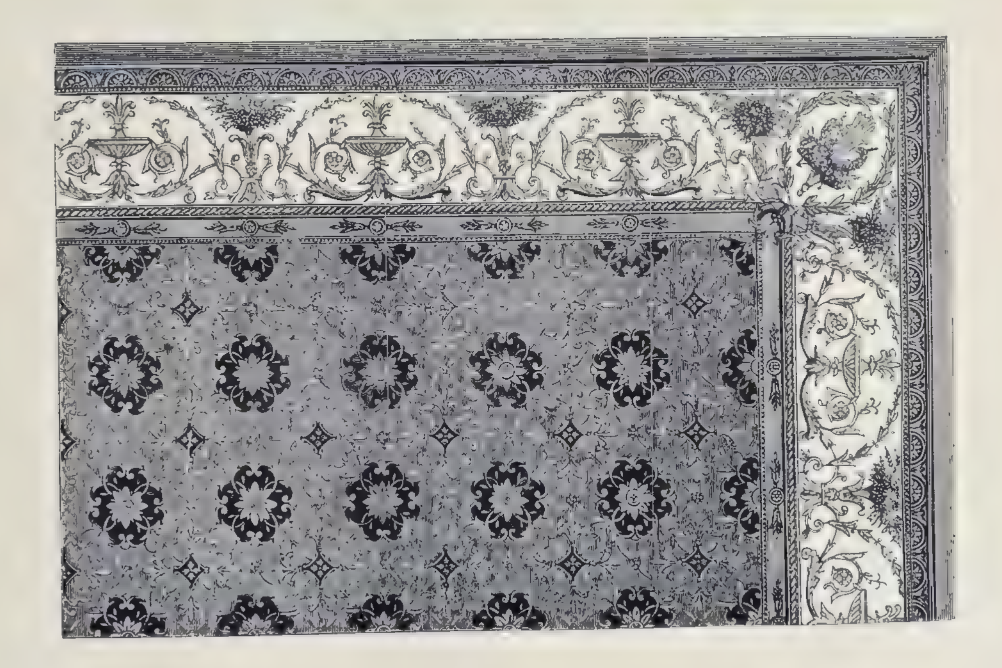
WE conclude our illustrations of Messrs. Tomkinson and Adams' beautiful Carpets with two examples of their "Patent Axminster," of great novelty and excellence of design. They are both given on such a scale, and with such clearness, that the student will be able to study them with profit. The conventional mossy scroll-work is very curious, and well suited to carpet-work: the whole of the lower specimen, from the ground to the outer border, is pleasing in the extreme. The quantity of beautiful Carpets now produced in the United Kingdom is so large that the production of patterns for them must have a notable effect on our progress in design for Art-manufactures in general.



ENGLISH FLOOR-CLOTH.

THE last example of Floor-cloth for which we have space is copied from one of those beautiful mosaic works with which the Romans used to lay their floors. The production before us represents a pavement discovered some years since at Cirencester, which in the time of the Roman occupation of England bore the name of Corinium. It is, perhaps, the finest specimen amongst the many that have been found in this country; the central and four other medallions contain illustrations of the ancient legends relating to Diana, Actæon, the Centaurs, and others, while the corners are devoted to emblems of the Four Seasons, &c. This remarkable pavement was produced in oil-cloth by Messrs. John Hare & Co., of Bristol, with great success. We fill in the remaining space with a nice bit of simple bordering for oil-cloth.

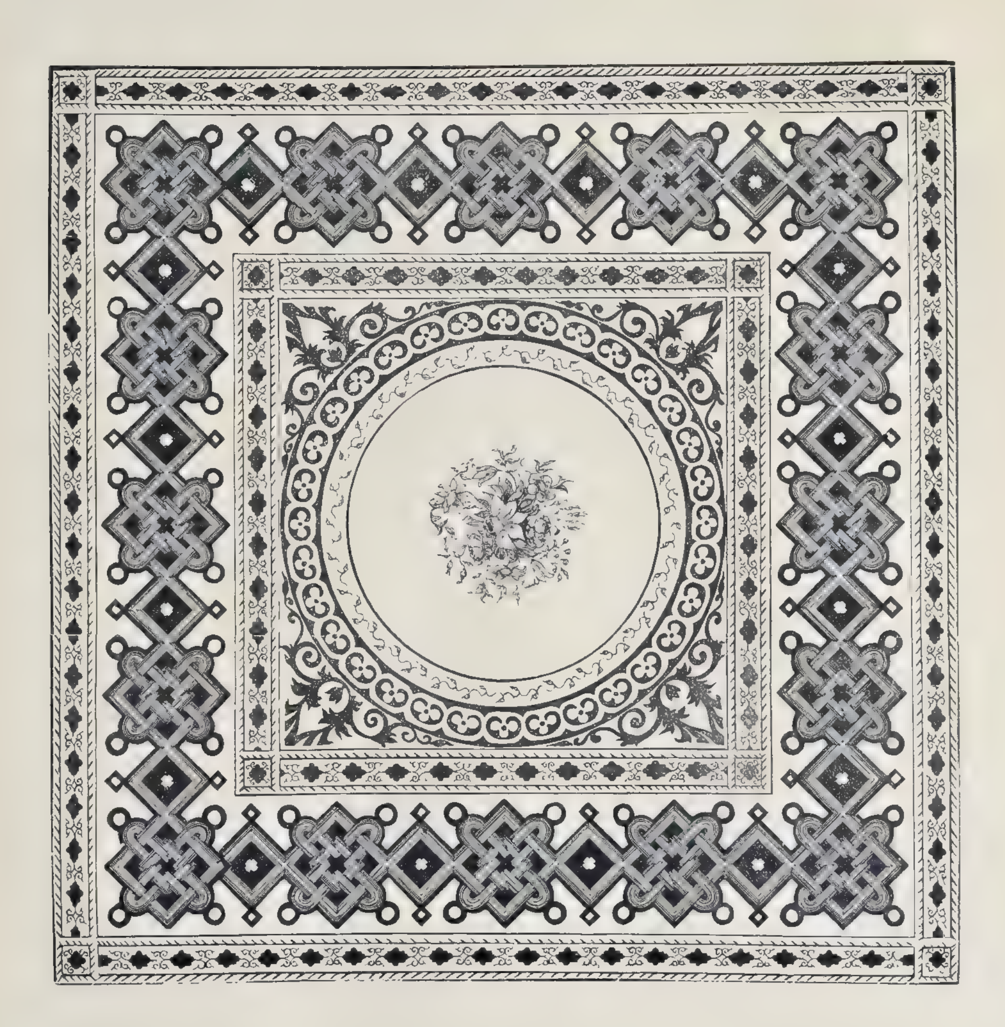




SCOTCH "AXMINSTER" CARPETS.

AMONGST the leading carpet manufacturers of the United Kingdom, Messrs. James Templeton & Co., of Glasgow, have taken their place, and have a well-earned reputation for excellent design and harmonious colouring as well as fine manufacture, and we are pleased to close our illustrations of this section of our work with two such charming examples as those here engraved. Different in design, but alike in taste, these two beautiful examples are worthy of the most careful study—they contain a dozen lessons; the grace, purity, and fitness of the whole are striking.

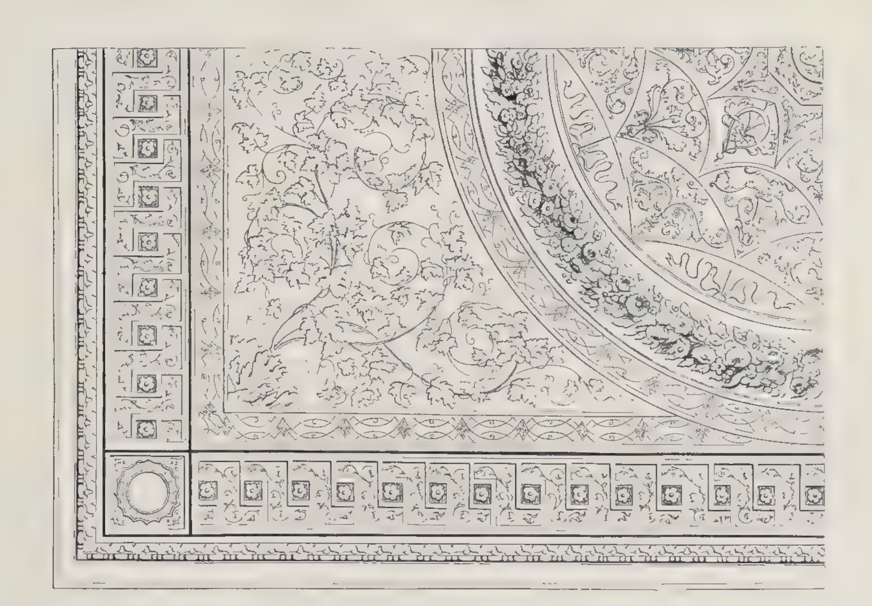
Philadelphia has been the theatre of fresh honours for our distinguished carpet manufacturers, and every year adds to their reputation.



ENGLISH FLOOR-CLOTH.

A HIGHLY appropriate and effective example of design in Floor-cloth by Mr. R. Y. Barnes, of London, and shown at the Great Exhibition of 1581. The interlaced pattern of the border and the ornaments which occupy the angles outside the circles are capital, and the whole forms a good example of the flat treatment which alone is in place on a floor.





FRENCH AND ENGLISH TABLE-COVERS.

THE circular Table-cover, of which half the pattern is shown above, is an example of beautiful tapestry work, the result of the combined talents of M. Clerget, an admirable designer, and Mdlle. Husson, both of Paris: the pattern is an admirable adaptation of the arabesque, beautifully drawn. The work is executed in the finest silks and wools.

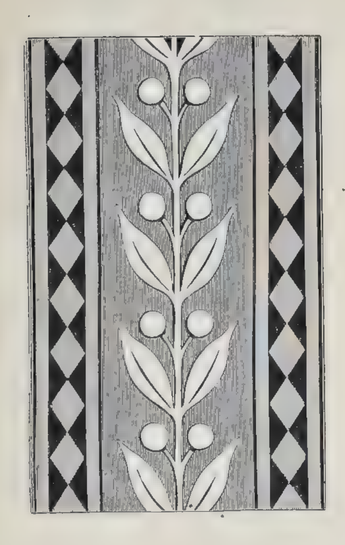
The second example is of the same kind of work, but in a totally different style, the artist being Mr. Gruner, and the executants Mrs. Purcell and her assistants. The pattern is full of variety, every portion being worked out with artistic knowledge and skill; the centre presents a charming piece of work, and the foliage scrolls of the ground are most delicate and yet full of effect.

Both works date back to 1851.

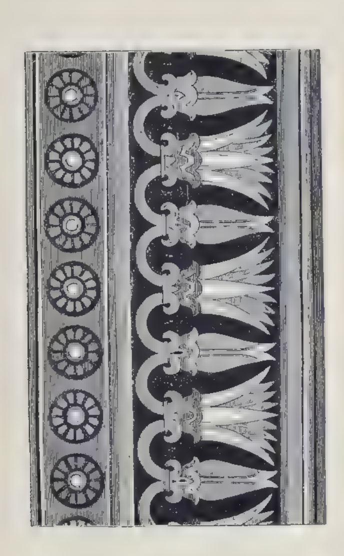


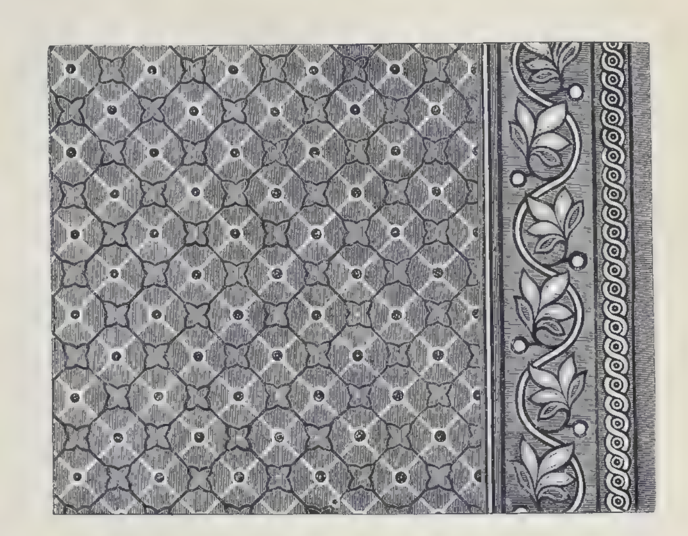
ENGLISH TABLE-COVER.

A TABLE-COVER designed and executed by Messrs. Webb and Son, of Spitalfields, for Messrs. Dewar & Co. of London, and shown at the Great Exhibition. The flowers—all, or nearly all, our familiar beauties—are drawn with a bold hand, and disposed in such a manner as to produce an exceedingly rich effect without confusion or heaviness. The contrast produced by the alternation of the delicate convolvulus, and the oak, and the ivy, all running up towards the centre, is very happy.



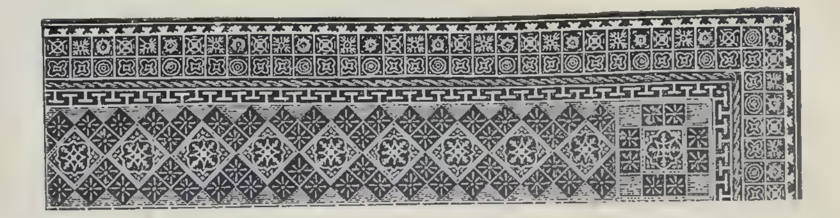






KAMPTULICON.

ONE, and perhaps the most remarkable, of a number of new fabrics for the covering of floors which have come into extensive use in this country—where alone, we believe, they are made—of late years. Kamptulicon, a word made up from two Greek words signifying elastic covering, is said to have been invented in 1843, but obtained little notice until the late Sir Charles Barry adopted it for the corridors of the new Houses of Parliament. It is composed of india-rubber and cork, both in the state of refuse, or, at any rate, in their cheapest forms, and the fabric has the high recommendations of being impervious to damp, elastic, and noiseless; hence it may be laid on stone or cement floors, and is peculiarly applicable to public libraries, &c., where quiet is a necessity. It is used where no ornament is required of its natural neutral colour, but it takes other colours admirably, and when decorated with light designs its tone is excellent. Fortunately, the makers of it have had the taste to adopt very elegant patterns, especially in the Etruscan and Pompeian styles, and this has recommended kamptulicon to many persons. The examples here given are excellent instances in point; they are the production of Messrs. Tayler, Harry & Co., of London. The other new kinds of floor-covering will be found mentioned elsewhere.





ENGLISH FLOOR-CLOTH.

A GOOD example of a peculiar English manufacture by Messrs. Hare, of Bristol—large producers. Oil-cloth can only be regarded as a cheap imitation of mosaic or tesselated work, and here we see it treated in a perfectly legitimate manner by the repetition of simple geometric forms, judiciously varied, with the introduction of armorial bearings in the centre. Of course much of the effect of such a production depends upon the selection of the colours employed, and the young ornamentalist could not do better than take a portion of this pleasing geometric composition and work it out as a lesson in colouring. The effect of the work is diminished from the fact that space did not admit of the production of the whole on a commensurate scale ; the figure above shows how the border is carried round.



